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EDISON ELECTRIC INSTITUTE BULLETIN

Taxation of Utilities in Great Britain 89
Missouri River Development . . . . . D. W. SNYDER 95
Price of Electricity and Cost of Living 98
A New Plan for Financing Appliance Installment Sales
L. A. MAYO 99
Another Fire Insurance Rate Reduction Is Negotiated
by Insurance Committees. 100
Post War Domestic Air Conditioning and Related Power
System Distribution Problems . . . J. W. ANDERSON 101
Impulse and Dielectric Strength Tests
on Various Insulating Tapes . . . . G. B. McCABE 104
Industrial Lighting—A Symposium
Introduction . . . . . THOMAS E. GRAHAM 107
Industrial Incandescent Lighting. . . . . W. R. WHITE 107
Industrial Fluorescent Lighting . . . . . R. F. DICE 109
Cold Cathode Lighting . . . MARSHALL A. HAVENHILL 110
Wisconsin Utilities Association Establishes Fellowship
for Farm Research . . . . . A. F. HERWIG 112
Little Known Facts About Electricity That
I Never Learned in College . . . . . C. M. RIPLEY 113
Electrical Hazards and High Tension Fires A. G. HARRISON 115
Personals 118
EEI Publications and Service Material 119

PUBLISHED MONTHLY BY EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

December, 1943 and 1944

SOURCE AND DISPOSAL OF ENERGY—MONTH OF DECEMBER

	1944	1943	%
GENERATION* (Net)			
By Fuel Burning Plants	13,623,972,000	14,667,876,000	− 7.1
By Water Power Plants	6,206,417,000	5,587,998,000	+11.1
Total Generation	**19,830,389,000**	**20,255,874,000**	**− 2.1**
Add—Net Imports over International Boundaries	122,802,000	121,431,000	+ 1.1
Less—Company Use	150,855,000	142,055,000	+ 6.2
Less—Energy Used by Producer	241,839,000	1,024,884,000	−76.4
Net Energy for Distribution	**19,560,497,000**	**19,210,366,000**	**+ 1.8**
Losses and Unaccounted for	2,616,522,000	2,303,186,000	+13.6
Sales to Ultimate Customers	**16,943,975,000**	**16,907,180,000**	**+ 0.2**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of December 31st			
Residential or Domestic	27,371,260	26,872,639	+ 1.9
Rural (Distinct Rural Rates)	1,144,241	1,088,698	.....
Commercial or Industrial:			
Small Light and Power	4,263,395	4,168,245	+ 2.3
Large Light and Power	151,652	146,593	
Other Customers	117,844	120,125	.....
Total Ultimate Customers	**33,048,392**	**32,396,300**	**+ 2.0**
KILOWATTHOUR SALES—During month of December			
Residential or Domestic	2,895,721,000	2,622,947,000	+10.4
Rural (Distinct Rural Rates)	224,005,000	215,844,000	+ 3.8
Commercial or Industrial:			
Small Light and Power	2,641,855,000	2,499,160,000	+ 5.7
Large Light and Power	9,480,688,000	9,649,985,000	− 1.8
Street and Highway Lighting	219,760,000	214,341,000	+ 2.5
Other Public Authorities	695,839,000	944,953,000	−26.4
Railways and Railroads:			
Street and Interurban Railways	458,963,000	430,220,000	+ 6.7
Electrified Steam Railroads	249,092,000	239,882,000	+ 3.8
Interdepartmental	78,052,000	89,848,000	−13.1
Total to Ultimate Customers	**16,943,975,000**	**16,907,180,000**	**+ 0.2**
Revenue from Ultimate Customers (Net after refunds, etc.)	**$279,632,900**	**$273,739,800**	**+ 2.2**

RESIDENTIAL OR DOMESTIC SERVICE

AVERAGE CUSTOMER DATA—For 12 months ended December 31st			
Kilowatthours per customer	1,151	1,070	+ 7.6
Average Annual Bill	$40.40	$38.52	+ 4.9
Revenue per Kilowatthour	3.51¢	3.60¢	− 2.5

(*) By courtesy of the Federal Power Commission.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 13 APRIL, 1945 No. 4

Taxation of Utilities in Great Britain

A Study by Ebasco Services Incorporated

IN a memorandum issued under date of Jan. 24, 1944, it was shown that in Great Britain the income tax is applied generally in the same manner and to the same extent to government-owned and private-enterprise utilities. In view of the widespread interest in tax matters generally and the British tax system particularly, the development of further information on the British practice and background seemed desirable.

As has been mentioned, in Great Britain the government owned utilities are generally subject to income tax in the same manner and to the same extent as the private-enterprise utilities. Likewise, the government owned utilities pay local taxes (known as rates). To assist in appraising the significance of these British practices, it is desirable to outline briefly something of the history of the organization and development of British utility systems and utility tax practices and to give some information as to their experience in the administration of their utility taxes.

Development and Status of British Utilities

About three-fourths of gas utility operations in Great Britain are privately owned and one-fourth municipally owned. With respect to electric utilities approximately 40 per cent of the enterprises, and production capacity, are privately owned and 60 per cent are publicly owned.

With a desirable degree of tax equality between publicly and privately owned utilities, the question arises as to why municipal ownership of electric enterprises predominates. The authorities seem to agree that the early legislative policy on the regulation of electric utilities had the unfortunate effect of retarding progress in the development of the electric industry, both publicly and privately owned, with a particularly restrictive effect on the development of privately owned electric systems.

For example, for many years it was required that any franchises granted to companies must contain provision giving the municipality right to take over the enterprise at the end of twenty-one years (later changed to 42 years), and highly restrictive provisions had been in effect with regard to the assignment or transfer of electric franchises. By the time the retarding effect on the industry generally of the restrictive measures was realized and provisions were made for providing electric service outside of the municipal boundaries, practically all of the principal cities were served by municipal plants and private enterprise was left only to fields represented by rural areas, small towns and city-fringe areas.

The retarding effect of these restrictive legislative and regulatory policies on the industry generally is illustrated by the extremely confused situation in London, where, for example, in 1936 there were several dozen different electric undertakings (electric enterprises, publicly and privately owned) serving the city at a number of different voltages and frequencies. Over a period of years several official commissions investigated the situation, particularly studying the electric systems in the United States, and finally the famous British Grid System was organized and developed to bring the country up-to-date electrically, to integrate and interconnect electric systems in a manner theretofore prohibited. With the Grid System in operation and with the accompanying provisions for equipment standardization, considerable progress has been made technically and commercially in electrical development. The Central Electricity Board owns and operates the back-bone transmission system, directs the operation of the selected baseload generating stations, and apportions the overall generating and transmission costs among the privately and municipally owned distributing agencies.

Legal, Economic and Tax Concepts

Under the British Income Tax Act all gains and profits from trading activities are subject to taxation. Since the Act contains no provision similar to Section 116(d) of the Internal Revenue Code (which provides for the exemption from taxation of income derived from any public utility or the exercise of any essential governmental function and accruing to any State or political subdivision thereof) the problem of whether government owned utilities are taxable resolves itself into the question: What are trading profits?

The British courts have generally held that government owned utilities are subject to taxation to the same extent as their privately owned competitors. However, the courts have exempted government owned utilities from taxation in the following situations:

1. Where the Act of Parliament creating the particular government owned utility contains a specific clause exempting its receipts from all taxation.—A review of leading tax cases indicates that few enabling statutes contain such a clause and that the British courts have strictly construed such provisions against the party claiming exemption thereunder.

2. Where the government owned utility is conducted by the Crown as a national enterprise.—Thus, the British Broadcasting Corporation, a government corporation, which has a national monopoly of the broadcasting business and which is supported by license fees on radio receiving sets is not taxable on the income derived from such fees.

3. Where the income of the government owned utility is derived from a compulsory rate levied on all consumers within a particular district, whether they take the service or not, and any surplus is used to reduce the compulsory rate in the succeeding year.—In an early case involving a municipally owned and operated waterworks the municipal authorities, by an Act of Parliament, were empowered to levy a compulsory water rate on all dwelling houses within the municipal boundaries. The act directed that any surplus resulting from excess of income over annual expenses should be applied to reduce

the compulsory rate in the following year. The Court held that as the sellers and buyers were in fact the same, i.e., the ratepayers and people can not trade with themselves, such surplus could not be regarded as income from trading within the meaning of the Income Tax Act.

In the ordinary case, the government owned utility is run as a local enterprise and liability for payment for service is dependent on the exercise of the option to take such service. In such a case, the enterprise does not fall within any one of the three exceptions hereinbefore discussed and consequently the government owned utility must pay an income tax on the same basis as its privately owned competitors. A government owned utility is chargeable with tax on income derived from services supplied by agreement outside the compulsory rate district, or within the compulsory rate district where the service is taken on a contractual basis. Furthermore, each trading activity of the municipality is regarded by the Courts as a separate entity and the expenses arising from nontaxable activities such as lighting the public streets can not be charged against income derived from supplying private customers in the determination of tax due.

The facts of the following case are illustrative of the point of view of the Courts. By a special Act of Parliament, a duty was imposed upon a municipal corporation to supply public lighting in a particular town as a condition precedent to the exercise of its privilege to supply private consumers with gas. In subsequent litigation the court held that the municipality was required to pay income tax on the profits derived from the sale of gas to private customers, but denied the corporation the alleged right of deducting the street lighting expenses from gross income.

While the discussion and emphasis herein is with respect to the National Government's income tax, similar legal concepts and decisions apply to the taxing of public utility undertakings, whether privately or municipally owned, under municipal or local property taxation (known as, local rates).

There have been few public expressions by representative authorities of the reasons for the taxation of government owned utilities in Great Britain. The courts have taken the position that the language of the Income Tax Act is very broad and all inclusive and unless they can find that the facts fall within one of the factual situations outlined above, they have consistently held that a government owned utility comes within the meaning of the Act. In most of the tax cases involving this subject the local authorities as well as the Crown assumed that the utility was subject to tax and the issues were confined to more specific provisions of the Act. The general assumption that government owned utilities are subject to taxation is well illustrated by the following excerpt from the Report of the 1920 Royal Commission on the Income Tax[1]:

"The fundamental question whether a corporation municipal ought to pay income tax at all was not pursued by the witnesses, representatives of sundry districts, towns, cities, etc., possibly because they recognized that although the burden of the income tax paid by a corporation ultimately falls upon the members of the local community, the ratepayers are in many cases liable to income tax, and any burden of taxation removed from them as ratepayers must necessarily be thrown upon them, though not necessarily in the same proportions, in their capacity as taxpayers. It may also have been in their minds that it would not be expedient to claim exemption from income tax for public bodies which are actually or potentially competitors of private persons or companies carrying on similar trading undertakings."

In Great Britain the customers of all public utilities contribute to the expense of the national government through the reflection of the income tax in their rates for services purchased. This equitable distribution of the national tax burden is in sharp contrast with the situation in the United States where the customers of the private enterprise utilities not only pay their share of the burden but in effect are bearing a share of the tax burden attributable to the customers of the tax-free government owned utilities.

Extent of Tax Payments by Government Owned Utilities

The tabulation on the next page has been abstracted from returns made to the Office of the Electricity Commissioners (central regulatory body):

It is to be noted that the small amount of the income taxes reported by the privately owned utilities, as compared with that of the publicly owned utilities, requires adjustment, for comparative purposes, by reason of the fact that all interest and dividend payments are reported gross, i.e., inclusive of applicable income taxes withheld. Making approximate adjustment for this increases to approximately 2,637,000 pounds the income taxes paid by the privately owned utilities as compared with the 2,979,000 pounds paid by the government owned utilities. In terms of percentage of gross revenue, the private enterprise utilities were paying approximately 7 per cent of their gross revenues in income taxes as compared with 5.2 per cent for the government owned utilities. The rate of income tax during this period was 22¾ per cent. The present rate is 50 per cent and there is also an excess profits tax.

As to the extent of local taxes paid by the utilities, it will be noted that the working expenses (operating expenses) in the preceding tabulation include at least 2,973,000 pounds local taxes in the case of the government owned utilities and 2,147,000 pounds in the case of the privately owned utilities. In other words, the government owned utilities were paying 5.1 per cent of gross revenues in local taxes and the privately owned utilities 5.7 per cent. Also in this same year the publicly owned utilities allocated 585,000 pounds to what is called "Net contributions in relief of rates" (local taxes), that is, contributions toward reduction of local taxes.

Taking the annual statement of the Electricity Accounts (Department) of the City of Portsmouth for the year ended March 31, 1934, as an individual example, it is noted that operating revenues totaled 363,254 pounds and included 25,782 pounds of street lighting revenue. Local taxes amounted to 13,600 pounds or 3.8 per cent of gross revenue. Income taxes amounted to 17,059 pounds or 4.7 per cent of gross revenue. The contribution in aid of rates (taxes) amounted to 15,373 pounds, the statutory limit applicable, which was 1½ per cent of the net bonded indebtedness of the Electric Department. The municipality's annual report made special mention of a substantial increase in the local property tax assessment applicable to the Electric Utility Department. The annual report of the Electric Department of the City of Glasgow made mention of a reduction in the local property tax assessment.

Administration of Taxes on Government Owned Utilities

Mr. H. B. Spaulding, an authority on British taxation, writing a number of years ago, made mention of the fact that it is always possible for a municipality to keep its profits down to nothing by regulating the rates and charges for its services. The income tax amounts paid give some evidence that to some extent rate reductions to avoid

[1] "Report of the Royal Commission on the Income Tax for 1920," p. 117.

TAX PAYMENTS BY UTILITIES IN GREAT BRITAIN

For the Fiscal Year 1937-1938

(Amounts in Thousands of Pounds Sterling)

Item	*Government Owned Utilities*	*Private-Enterprise Utilities*
Revenue from working	57,754	37,655
Working expenses—Costs and expenses, excl. local rates	37,121	21,121
Local rates (taxes)	2,973	2,147
Total Working Expenses	40,094	23,268
Surplus	17,660	14,387
Other Revenue	6,177	5,254
Gross surplus	23,837	19,641
Appropriations:		
Interest charges	6,541*	3,091*
Preference dividends	.....	1,389*
Ordinary dividends	.....	6,216*
Income tax	1,491	204
Loan repayments and transfers to sinking funds	10,804	.....
Net transfers to depreciation and reserve funds	1,476	7,990
Special expenditures, including amounts applied to capital outlay	3,328	.....
Net contributions in relief of rates (taxes)	585	.....
Net increase in balances of net revenue	(388)	424
Transfers to appropriation accounts common to combined undertakings (e.g., electricity and gas undertakings)	.....	327
Total	23,837	19,641

* Interest charges and dividends are stated on a gross basis, i.e., are inclusive of the income tax applicable which is withheld and paid to the Government.

Adjustment to Put Income Tax on Comparable Basis

Income tax, as above	1,491	204
Income tax, at 22¾%, on interest and dividends (included in gross interest and dividend amounts shown)	1,488	2,433
Income tax, adjusted	2,979	2,637
Percentage relationship to working (operating) revenue	5.2	7.0
Percentage relationship of local taxes and income taxes to working (operating) revenue	10.3	12.7

income taxes have been made by municipalities. However, inability to do so, or lack of desire to accomplish this tax avoidance, is evidently widespread, as evidenced by the substantial income tax payments made.

Similarly, while there may be some manipulation of the local tax assessments of municipalities on their own utility departments, with a view to income tax avoidance, no evidence of widespread practicing of such avoidance was encountered.

Mention has already been made of the regulatory requirement that contributions from a municipality's electric department toward the reduction of local taxes may not exceed in any one year 1½ per cent of the amount of the electric department's bonded indebtedness. This 1½ per cent contribution may not be made until there is a reserve fund, that is, surplus, of at least 5 per cent of the total capital expenditure on the undertaking. This regulation apparently originated from early controversies on the subject and the limitation has in mind the barring of substantial reductions in local taxes of large property owners at the expense of the many users of gas and electricity.

With regard to the question of administration of the taxes and tax avoidance, it is pertinent to point out that all the electric and gas utility undertakings, both public and private, appear to be subject to comprehensive regulation by various agencies of the National Government. The electric departments of the principal municipalities for a great many years have followed the practice of issuing annual reports certified by independent chartered accountants and the small municipal utilities are subject to audit by central or district government auditors.

(The appendix at the end of this study consists of interesting excerpts from "Municipal Trading, a Study in Public Administration," by Herman Finer, London, 1941.)

Application of British Excess Profits and Income Taxes To An American Electric Utility Company for the Year 1943

As an additional means of comparing British and American income tax provisions and administration, an application will be made of the British excess profits and income taxes to the income of an American electric utility company for the year 1943.

The War-time income tax laws of Great Britain consist of an Excess Profits Tax (or National Defense Contribution) and an Income Tax.

Excess Profits Tax

All business undertakings in Great Britain, pay, first, the Excess Profits Tax of 100 per cent on the increase of profits of the taxable period over standard profits. Standard profits represent profits of standard years lying between the years 1935 and 1937. A business organized prior to 1935, may choose as the standard year, the year 1935 or 1936, or the average profits of the years 1935 to 1937, or of the years 1936 and 1937. The profits of the year selected by the taxpayer, plus a sum equal to 6 per cent of net increase in capital since the standard period, are used as the exemption or credit in the calculation of the excess profits tax.

All profits in excess of the standard profits exemption are taxable at 100 per cent, of which 20 per cent is refundable after the war, after deduction of income taxes at the contemporary rate. The refund is intended to help reconversion and will not be available for distribution as dividends.

The law provides that if profits of the standard period are too low and not typical of profits of the pre-war period the Commissioner may authorize a higher standard profit of not exceeding 6 per cent invested capital (8 per cent in certain limited cases).

Income Taxes

After the Excess Profits Tax has been paid the remaining profits (equal to standard profits) are subject to Income Tax at the current rate of 50 per cent applied to the statutory profits.

Statutory Profits

Statutory profits (equivalent of net taxable income under American law) represent the net balance of the profit and loss accounts after certain adjustments.

The principal adjustment to book profits, as compared with American practice, is the disallowance of interest paid on mortgage or debenture bonds as a deduction for tax purposes. Under British law interest on mortgage bonds and

debentures is considered to be a distribution to owners and the taxpayer is required to recoup the income taxes (not excess profits taxes) from the bondholder at the time the interest is paid. Amortization of bond discount and other expenses of securing capital funds, also, are not allowable deductions. Interest on bank loans is allowed and it is assumed that interest on customers' deposits would be allowable as a deduction for income tax purposes.

Reserve appropriations, including depreciation reserve, are disallowed and the actual costs incurred are substituted. In the case of depreciation, the taxpayer is allowed the cost of replacements actually made or obsolescence in the case of retirements not involving replacement. The taxpayer has the alternative of claiming an allowance for "wear and tear" where the asset concerned comes under the head of plant and machinery. The rates for specific property under the "allowance for wear and tear" for electric utilities are higher than rates of depreciation under American practice but the British rates are applied to the diminishing "value" of the asset which would tend to bring the overall allowances to approximate agreement.

Dividend and interest income are not includible in computing the "Statutory Profits" of corporate taxpayers as the taxes of the interest and dividend payer were computed on the entire gross income of the business, and the applicable amount of such tax withheld from the net interest or dividend payment made to the taxpayer. Rentals received on business property are likewise not includible in Statutory Profits as taxes were deducted by the lessee at time of payment.

Application to American Company

Schedule 1 of Exhibit I shows the calculation of Excess Profits and Income Taxes for an American company for the year 1943 under the British Income Tax law and also a comparison of American and British taxes applicable to the taxable income of the company.

The "Statutory Profits" of the taxable period, and the "Standard Profits" for the period selected by the taxpayer, are calculated on and brought over from Schedule 2. The "Statutory Profits" of the years 1935, 1936 and 1937 are computed on Schedule 3, from which the average profits of the years 1936 and 1937, are claimed as "Standard Profits." To the "Standard Profits" for this period is added an allowance of 6 per cent on net additions to invested capital since 1937 to arrive at the amount of "Standard Profits" for the taxable period.

The amount of the "wear and tear allowance" used in calculating "Statutory Profits" for the year 1943 on Schedule 2 and the years 1935, 1936 and 1937 on Schedule 3, represents the amount of depreciation allowed or claimed by the company for Federal Income Tax purposes. This amount was used in lieu of calculating the "wear and tear allowance" on the basis of the British depreciation rates for various types of property because of the difficulty in determining a composite depreciation rate for the property as a whole, on this basis, and the difficulty in determining depreciation accrued to the present period under British rates for determination of the depreciated basis on which British rates are ordinarily applied. While British depreciation rates are generally higher than American rates it is believed that the overall allowance will not differ greatly due to the difference in the methods of applying the rates.

SCHEDULE 1—EXHIBIT I

AN AMERICAN ELECTRIC UTILITY COMPANY

COMPUTATION OF EXCESS PROFITS TAXES YEAR 1943
ON BASIS OF BRITISH INCOME TAX LAW

Statutory Profits - (Schedule 2)	$1,223,000
Less - Standard Profits - (Schedule 2)	887,000
Balance - Taxable at 100% for purpose of Excess Profits Tax	$ 336,000
Less - Amount of Post-War Refund (20% of amount of Excess Profits Tax less Income Tax rate applicable for year of refund - 50% used) 20% x $336,000 x 50% = Part Charged to Deferred Debits - Post-War Refund	33,600
Balance - Chargeable to Current Year Tax Expense	$ 302,400

COMPUTATION OF INCOME TAX - YEAR 1943
ON BASIS OF BRITISH INCOME TAX ACT

Statutory Profits - (Schedule 2)	$1,223,000
Less - Excess Profits Tax calculated above	336,000
Balance - Statutory Profits subject to Income Tax	$ 887,000
Income Tax (50% of Statutory Profit)	$ 443,500
Less - Income Tax applicable to interest on bonds recovered from bondholder (50% of $375,000)	187,500
Net Income Tax paid by Taxpayer	$ 256,000

COMPARISON OF INCOME TAXES UNDER
BRITISH AND AMERICAN INCOME TAX LAWS

	British Taxes	American Taxes
Excess Profits Tax - net	$302,400	$397,000
Surtax		9,000
Income Tax - normal	256,000	88,000
Total	$558,400	$494,000

Note.—Any comparison of amount of British and American taxes must also consider that under the American system the individual stockholder is subject to normal income tax and graduated surtax rates on the amount distributed while the British individual taxpayer is permitted to credit against his income tax the amounts already withheld from dividends he has received.

Application of American Income Tax Statutes to American Government Owned Utilities

The preceding discussion of the British administration of income taxes on government owned utilities and the comparison of British and American income tax statutes and administration indicates that there are no insurmountable obstacles to the application of our income tax to our government owned utilities. This British experience indicates that the problems which would arise in extending the income tax to include the presently exempt utilities would be no more difficult than those met and solved in the British system, and in other aspects of our own system.

The fact that the British taxation of government owned utilities functions with the aid of officials and accountants of the municipal utilities who have long

SCHEDULE 2—EXHIBIT I

AN AMERICAN ELECTRIC UTILITY COMPANY

DETERMINATION OF STATUTORY PROFITS - YEAR 1943

Net income per books	$ 520,000
Add - Bond interest	375,000
Interest on advances	-
Retirement reserve appropriations	400,000
Federal income taxes	97,000
Federal excess profits taxes	397,000
Amortization of debt discount and expense	3,000
Uncollectible accounts reserve accruals	3,000
Injuries and damages reserve accruals	9,000
Inventory adjustment reserve accruals	-
Total	$1,804,000
Less - Wear and tear allowance (depreciation claimed)	$ 570,000
Bad debts written off	2,000
Injury and damage claims paid	10,000
Inventory adjustments	1,000 (R)
Total Deductions	$ 581,000
Balance - Statutory Profits - Year 1943	$1,223,000

DETERMINATION OF STANDARD PROFITS FOR EXCESS PROFITS TAX PURPOSES

Standard Profits (Average of years 1936-1937) (See Calculation Schedule 3)	$ 857,000
Add - 6% of Net Increase in Capital 1-1-1938 to 12-31-1943 (6% of $500,000) =	30,000
Standard Profits - Year 1943	$ 887,000

SCHEDULE 3—EXHIBIT I

AN AMERICAN ELECTRIC UTILITY COMPANY

DETERMINATION OF STANDARD PROFIT FOR PURPOSE OF BRITISH INCOME AND EXCESS PROFITS TAXES

	Year 1935	Year 1936	Year 1937	Average Year 1936 - 1937
Net income - per books	$ 250,000	$ 450,000	$ 510,000	
Add - Unallowable deductions				
Interest on advances	170,000	170,000	170,000	
Bond interest	397,000	380,000	358,000	
Retirement reserve appropriations	350,000	350,000	350,000	
Federal income taxes	18,000	50,000	60,000	
Amortization of debt discount and expense	16,000	7,000	7,000	
Uncollectible account reserve accruals	3,000	57,000r	9,000	
Injuries and damages reserve accruals	-	10,000	6,000	
Total	$1,204,000	$1,360,000	$1,470,000	$1,415,000
Less - Wear and tear allowance*	$ 535,000	$ 538,000	$ 537,000	
Bad debts written off	39,000	19,000	9,000	
Injury and damages paid	-	5,000	8,000	
Total deductions	$ 574,000	$ 562,000	$ 554,000	$ 558,000
Balance - Statutory Profits	$ 630,000	$ 798,000	$ 916,000	$ 857,000

r - Indicates red figure.

* - Represents depreciation claimed or allowed for Federal income tax purposes.

been trained to deal with the cost accounting problems involved prompts the thought that extension of the income tax to include government owned utilities may have an important collateral advantage in this country in improving the standards and objectivity of cost accounting in government owned utility operations.

APPENDIX TO TAXATION OF UTILITIES IN GREAT BRITAIN

The following excerpts are from a volume published in London, in 1941, entitled "Municipal Trading, a Study in Public Administration" by Herman Finer.

". . . It should be remembered that apart from these post-war exceptions, the local authorities are free to aid the rates (local taxes) out of the profits of the undertaking. They are, like other profit-making concerns, liable to income-tax; and they must also be assessed for rates (local taxes)."

"THE ALLOCATION OF CENTRAL ESTABLISHMENT CHARGES

"It is impossible to arrive at an accurate estimate of the 'success' of municipal undertakings unless they are debited with every charge for which their activities are responsible. This problem has worried the municipalities themselves, and much more the critics of municipal enterprise for two generations. It may be said that on the whole, but not universally, this matter has received a satisfactory solution in practice. The answers to the enquiries sent out by the Departmental Committee on the Accounts of Local Authorities (Report, 1907), showed a remarkable variety of practice and principle. The Committee concluded that

"'sufficient attention has not been paid to questions of this kind by local authorities. As regards establishment charges, for example, many authorities seem to have attempted no apportionment between the different departments, and in others there is reason to suppose that the allocation may have tended to favor one fund at the expense of another. It is plain that all these questions (and there are many others of a similar character) have an important bearing on the accuracy of the statement of profit and loss. It is equally plain that they are questions which cannot be dealt with adequately by general regulations; each case must be treated separately on its own merits and in accordance with the particular circumstances.'"

"Since 1907 the practice of local authorities has vastly improved as a result of continued stimulation of the auditors, the Ministry of Health and the steady work of the Institute of Municipal Treasurers and Accountants. Mr. William C. Coxall, the Borough Treasurer of Chesterfield, who has been a pioneer in this as in other municipal accountancy questions, has reported the results of an enquiry which he made by questionnaire in 1925. The answers from the sample of the twenty-three authorities from whom replies were received, showed a variety of practice involved in estimating the factors in the recurring phrase 'according to services rendered.' In some cases there appears to have been a general guess rather than a calculation; in other cases there is a calculation of time spent by the Town Clerk's department, and the Finance Department, on the special work of the trading undertakings, and the rent due by these is calculated most frequently on the building space occupied, and this includes charges for heating, lighting, and cleaning. Probably the matter has been worked out to the finest degree by Mr. Coxall himself, and the principles of it deserve reproduction."

". . . The Rating and Valuation Act imposes upon local authorities the duty of including in their demand note for rates (taxes) the amount in the pound which is being levied for the expenses of the rating (taxing) authority, and the amount in the pound, if any, for each of the services rendered by the local authority. These provisions, and the rules and orders which have carried them out, have made it incumbent upon local authorities to declare clearly the amount, if any, in the pound levied to make good deficiencies in trading accounts, and the amount by which the rates (taxes) are benefited by transfers from trading surpluses.

"All this makes for clarity in an important issue. Assuming that one works for a surplus and achieves it, or that a surplus comes accidentally, is it to be applied to the relief of rates (taxes) or to the improvement of the undertaking by better service or the reduc-

tion of prices? In the early years of municipal enterprise, the hope of securing surpluses in order to aid the general rates (taxes) was actually a very strong inducement to its origination. . . . This motive is still strongly at work, despite new tendencies.

"Secondly, since the rates (taxes) are under liability in the event of loss it seemed fair to local authorities that they should try to obtain a surplus in order to offset any eventual liability. An extension of this view is applicable where a local authority supplies those who reside outside its own area. The liability for loss which falls on the supplying authority can be made good either by an equal price to all consumers, to yield a profit; or higher prices to the extra-municipal consumers. Both these methods, which are not mutually exclusive, are practiced.

"Thirdly, local authorities are much influenced by the belief that municipal credit benefits the undertakings by enabling them to save on the rate of interest on their loans, by as much, it has been commonly alleged, as 1½ per cent. This view of the matter, together with the hope of improving the general financial situation of the local authority, ruled the situation until 1919. Thenceforward, local authorities by local Acts or by the force of certain general statutes began to be restricted in the extent to which they could aid the rates (taxes). The policy was evolved between 1920 and 1930 by Parliament itself, through the Local Legislation Committee of the House under the chairmanship of Sir Thomas Robinson."

"While the majority of local authorities operate without restrictions such as those mentioned, since most came into existence before 1919, the actual tendency of the law is of much influence. The view is gradually gaining ground that there ought to be first, provision to develop the undertaking, 'to plough back' as the saying goes, and only then ought the remainder to be available for allocation to the benefit of rates (taxes). On the whole, the managing officials are more favorable than the councillors to 'ploughing back.' The latter usually think as ratepayers (taxpayers) and either want their rates (taxes) reduced, if they are egoistic (and happen to be small consumers of the utilities in comparison with the rates (taxes) they pay), or, if they are philanthropic, they want a bigger supply of money for the social services. The Council as a whole is usually stronger for rate (tax) aid than the committeemen concerned with a successful undertaking. Here are two typical expressions from officials.

"Mr. Foden, former Financial Controller, Manchester Electricity Department, notes with pleasure the fall in rate (tax) aid, and says, 'the best services municipal electricity supply can render are to sell as near to cost as is reasonably safe to attract rateable value by the supply, and to hasten the day when electricity consumers and ratepayers (taxpayers) are practically the same body.' Further, Mr. C. Owen Silvers, Manager, Wolverhampton Corporation Transport, emphasized as an ideal to be attained this resolution: 'The Council (of the Municipal Tramways and Transport Association) have laid down (1920) the sound financial proposition, with which the Ministry of Transport do not disagree, that this industry should be self-supporting, that it should be not subsidized by compulsory local taxation, and therefore that the rider should pay the cost of the ride in the fare charged.'

"It is becoming more clearly realized that a policy of making profits may result in some undesirable practices. There may be a skimping on the development of the 'service' side of the undertaking; an unduly harsh rejection of requests for transport on routes not thickly populated; or the pressure and purity of the water and gas supply may be kept low. The pursuit of profits is apt to lead to accountancy juggling, and overoptimistic valuation of assets. . . .

"The maximum rate (tax) aid usually suggested in argument is calculated in terms of the benefit which the undertakings are supposed to derive from the credit of the municipality, generally reckoned at a rate of interest of 1½ per cent. . . ."

"It might be observed that a full assessment to local rates (taxes) of the undertakings, though weighing on the consumer, assists the ratepayers (taxpayers); it also reduces the Income Tax payable on the profits of undertakings. Often, however, Councils stubbornly reject full assessment because the rate-charge results in smaller visible profits.

"A few observations are apposite here on the interpretation of statistics of profit and loss, in addition to the remarks made in Chapter Two.

"The extent of profits or losses in municipal trading is sometimes the result of errors in estimation; but the substantial proportions thereof are governed by policy.

"Where the policy is to supply at cost price, estimates of tariff yields and operating expenses may be cut so fine as to result in losses, or conversely may be so conservatively estimated by revenue or so liberally covered by the budget for expenditure, that there is a profit. Following the policy that some profit would be taken into account in the fixation of the tariffs for the next year, and correspondingly if there were a loss, the tariff might have been stiffened. In these days of the growth of electricity consumption, the tariffs might have to be maintained where with no deficit brought forward from the previous year, the tariff could have been brought down a little more than in the circumstances was then possible.

"In the field of gas and electricity, a constant policy of deficiencies is non-existent. It could not be defended in Council meetings. It would be criticized by the Ministry of Health and the Electricity Commissioners, when sanctions to loans, for instance, are sought. It would be severely handled by Parliament in any private Bill proceedings."

"Firstly, the professional officers, upon whom so much depends, have learned a devotion to a particular science and technology. . . . Membership of their professional associations fosters devotion to a criterion of public service, and continually stimulates to an improved standard of knowledge and application. Consequently, they work with energy and capacity for the success of their enterprise. Their pride is also continuously involved, since the statistics are locally scanned, and may be the object of comment in the Press and at professional conferences. Promotion for them, also, in their own authority, and beyond to more important enterprises in other parts of the country, is a spur to effort. . . .

"Secondly, acting occasionally and always potentially as a control over their technical ability and good faith, are the consulting engineers and financial and legal experts, whose independent, expert examination is not infrequently called in by councillors when they suspect that existing practice could be improved. Here, another set of motives and dispositions comes into operation, with an integrity independent of both technical officials and the Council. Considerations of colleagueship and elections are equally alien to these consultant investigators, who have their reputation to maintain before the eyes of the whole profession. That reputation is not infrequently on trial under the cross-examination of Parliamentary Counsel during proceedings for and against private Bills, and any reputed shortcomings would be costly."

"Fourthly, the councillors and the members of committee have the personal pride of successful management, economical administration, a flourishing town, and the desire, if possible, to extract a surplus for the benefit of the rates (taxes). . . .

". . . For those who live outside the Metropolis their town is their world. Public significance is almost all of significance, and is registered by the opinion of the neighborhood. The men and families are known; they rarely leave the town for another; their reputation over a number of years is dependent upon their work in the Council. Moreover, the commitee-men want their department to excel others, and their city to surpass the achievements of their neighbors, and their undertakings to surpass more cheaply and serve more gratifyingly than private undertakings. They keenly feel a setback. They certainly do not wish to show an adverse balance sheet, and still less to incur the opprobrium of asking for an appropriation from the rates (taxes) to cancel a deficit."

West Penn Offers Advisory Help to Veterans Who Plan to Farm

IN order that fewer mistakes may be made by combat weary veterans, seeking a peaceful and productive career on the farm after the strife and mud of the war theatres, the Monongahela System has arranged to provide for them, and for others in its territory, an advisory service on things agricultural. It has subscribed to the Doane Agricultural Service and, through its Rural Department, will be in a position to advise those persons considering farming or any other type of agricultural activity.

Following the first World War, there was every encouragement to returning veterans to purchase land and start farming. As a result, there were many misfits who started in agriculture without previous experience and without the knowledge that is essential to success on the farm. Many of them lost their initial investment as well as faith in some of their advisors. In offering the service mentioned without charge to all returning service men in its territory, the Monongahela System points out that very careful consideration should be given by inexperienced persons before committing themselves to the purchase of a farm.

Successful farming today demands more technical knowledge than was required a generation ago, these persons are reminded. Many problems have been faced by the agriculturist of the past, and many more probably will be faced in the future. The problem of agricultural surplus is one of the many that is yet to be solved. After five years of war, there still are certain surpluses, some of which are so large that they have broken the market, despite government support.

To assist the returning veterans, the Monongahela System will endeavor to find any agricultural question that is presented. Inquiries should be directed to the Rural Department, Monongahela System, Fairmont, West Virginia.—From the *Buckhannon Delta*, Buckhannon, W. Va.

Missouri River Development

By D. W. Snyder, Jr.

Missouri Power & Light Company, Jefferson City, Mo.

Presented before the Power Sales Conference, Missouri Valley Electric Association, Kansas City, Mo., Jan. 17-18, 1945

AUTHOR'S NOTE: The writer was requested to prepare a paper on the effect the proposed works for water utilization and control in the Missouri Valley will have on the utility interests in the valley. In an unguarded moment, and probably because the date for presenting the paper was still far in the future, I consented. It certainly was not because I then thought I could predict the future, at least if there was any such thought at the time the subsequent study of the situation has completely eradicated it. It is quite evident that at this time no one can make any positive predictions although certain facts and probabilities can be developed which may be helpful to you in arriving at conclusions.

PUBLIC LAW 634 of the 78th Congress 2nd Session, known as HR 4485, authorizes, among other things, "The general comprehensive plan for flood control and other purposes in the Missouri River Basin approved by the Act of June 28, 1939, as modified by subsequent Acts, is hereby expanded to include the works referred to in paragraph (a) to be undertaken by the War Department." The works referred to are those generally known as the Pick Plan.

This law, in paragraph (d) of Section 9, states, "In addition to previous authorizations there is hereby authorized to be appropriated the sum of $200,000,000 for the partial accomplishment of the works to be undertaken under said expanded plans by the Corps of Engineers." Paragraph (1) of the same Section states, "The sum of $200,000,000 is hereby authorized to be appropriated for the partial accomplishment of the works to be undertaken under said plans by the Secretary of the Interior."

There have been literally millions of words printed in the newspapers and magazines about this Valley Development. Nevertheless it seems necessary for a discussion of the subject to briefly relate or repeat a little of what has been published.

The Missouri River drains water that falls upon an area roughly equivalent to one-sixth of the area of the United States. The States in the area drained include Missouri, Kansas, Iowa, Nebraska, Minnesota, North and South Dakota, Montana, Wyoming, and Colorado. It also drains small portions of Alberta and Saskatchewan provinces in Canada. The only State that lies completely in the basin is Nebraska.

The Law referred to is a compromise bill as the interests of the various States differ greatly. This divergence of interests is indicated in the provision in the Law which divides the basin into Sections East and West of the ninety-seventh meridian. This meridian passes just east of Mitchell, South Dakota, and about twenty miles east of Wichita, Kansas. The area west of this meridian is principally interested in the local use of the water for irrigation and power purposes, while the area east of the meridian is principally interested in flood control and navigation. The Bill compromises the rival claims of the various States and the engineers of the War Department and the Department of Interior by providing that "Investigations which form the basis of any such plans (i.e. works for improvement or flood control), proposals, or reports shall be conducted in such manner as to give the affected State or States, during the course of the investigations, information developed by the investigations, and also opportunity for consultation regarding plans and proposals, and to the extent deemed practical by the Chief of Engineers, opportunity to cooperate in the investigations." The same opportunities given to the States are likewise to be made available to the Secretary of the Interior.

The above mentioned compromise was apparently necessary to secure the favorable votes from the ten States in the area for the Bill. The authorization of $400,000,000.00 for the area represents 42% of the total authorization in the Bill. In this connection it is interesting to note that 112 different projects in the 33 States were included in this Bill. With so many States securing large authorization of Federal Funds, support for the Bill was assured. This same procedure will no doubt be utilized from year to year in securing further authorization and actual appropriations to extend and complete such public works.

As previously stated it is impossible to predict with any degree of certainty just what will be done especially as to early developments of power for the simple reason that the final plans have not been determined. In order to convince Congress that the conflict of divergent aims in the area was not serious the Army Engineers and the Bureau of Reclamation entered into a written agreement on October 25, 1944, signed by General Eugene Reybold, the Chief of Engineers, and Mr. Harry W. Bashore, Commissioner of Reclamation of the Bureau of Reclamation, reconciling the engineering features of the two plans previously presented to Congress by their respective units. That agreement does not, however, provide a definite chart as to what will actually be constructed. In House Document No. 475 the letters from the Chief of Engineers, the Commissioner of Reclamation, the Chairman of the Federal Power Commission, and Land Use Coordinator of the Department of Agriculture, all indicate the extensive program would of necessity be carried out step by step with the details formulated progressively in cooperation with the various Federal Agencies and local interests.

It was on this cooperative basis that Congress passed the Bill ignoring a proposal by the President for an MVA authority similar to the TVA. The President signed the Bill with the statement that his action did not alter his opinion that an MVA authority was desirable or thus precluded. It is quite evident from editorials in the leading newspapers, resolutions by organizations, and statements by officials in the region, that an MVA is not wanted by the people in the basin. It is also likely that the threat of an MVA may bring about the necessary cooperation in the basin to carry out the program step by step as planned.

The Program proposes a nine foot channel in the Missouri River from St. Louis, Missouri, to Sioux City, Iowa, reservoirs and levees for flood control, multiple purpose dams for power, etc., and the irrigation of 4,400,000 acres of land. The important item of holding the rain where it falls gets scant mention.

The plan provides for twelve dams which are termed multiple purpose dams and at which presumably power will be produced. Five of these are on the main stem of the river making a chain of reservoirs stretching from Yankton, South Dakota, to Williston, North Dakota.

Yankton is located just north of the Nebraska border, and Williston is just east of the Montana border. Five multiple purpose dams are to be constructed on the five tributaries of the Republican River in southwestern Nebraska and northeast Colorado. One multiple purpose dam is to be located near the center of Wyoming on Big Horn River, and one multiple purpose dam is to be located north of Yellowstone Park in Montana on the Yellowstone River. The Pick Plan provides for ten additional single purpose reservoirs, all of which had been previously authorized by Congress. The Federal Power Commission Chairman, in commenting on the plan, wrote, "With a view to assuring the full use of power possibilities, the Commission recommends that the authorization for improvements in the basin be broadened to permit the War Department to construct on a multiple purpose basis, reservoir projects previously authorized for flood control only." Six of these dams are in Missouri, two in Kansas, one in Nebraska, and one in Colorado. In addition to these twenty-two large reservoirs, a map prepared by the Bureau of Reclamation locates scores of additional reservoirs for proposed irrigation projects in all of the States except Iowa and Missouri. Many of the latter will be potential power sites.

The big Fort Peck Reservoir on the Missouri River in northeast Montana was originally constructed in 1933-43 for the purpose of maintaining a six foot channel in the lower Missouri River. Later, water from this dam was permitted to be used for irrigation and 35,000 kw of generating capacity was installed. The potential power capacity of Fort Peck is reported as of 135,000 kw. There is no present market for the power output that can be generated at Fort Peck. A private power company in Montana has purchased a considerable portion of the Fort Peck output and has sold a considerable portion of it outside Montana in Idaho and Washington. There has been and is no power shortage in Montana, and additional power which the government may develop in that region will be difficult to dispose of for any useful purpose.

The situation in Nebraska is well known to this group. The entire State is now committed to public ownership of electrical power. There is a surplusage of power and the taxpayers, or the users, have already been saddled with millions of bonded indebtedness, some of which was actually created to cover deficit.

Just how many kilowatts of generating capacity will be installed in the basin initially or eventually is not known. The Federal Power Commission Chairman stated in his letter of December 14, 1943, addressed to Major General E. Reybold, that "On the basis of a preliminary review of previous survey, the Commission's staff is convinced that power development will prove an important factor in the Missouri Basin program. It appears that at least 10,000,000,000 kilowatt-hours of additional hydro-electric energy per year may eventually be developed in connection with the storage dams without sacrifice of the other benefits which the river and its tributaries should contribute to the growth and welfare of the region."

Assuming such a generation of power it would require 2,000,000 kw of installed capacity if it could be operated at an annual load factor of 60% which is unlikely for hydro-electric plants. Needless to say there is no present market for such a volume of additional power.

I have previously mentioned that there is no present market for all of Fort Peck's present generating capacity of 35,000 kw. The principal operating companies in Montana, the Dakotas, Minnesota, Iowa, Kansas and Missouri advise that there is no shortage of either capacity or reserve in their States. In Wyoming, a shortage of capacity is reported but there has been no curtailment of service. Contemplated installation of 15,000 kw of capacity by the Bureau of Reclamation in that area would amply provide the relief needed for reserves. This same Company, however, states this area in central and northern Wyoming is now almost entirely served by power developed incidental to irrigation works. The four hydro plants have a total installed capacity of 51,000 kva. The largest at Seminole with 36,000 kva is, however, limited in its output by the water supply in the North Platte River and its continuous capacity is probably not over one-third of its installed capacity. I mention this area in some detail as it is the only area in which there is any necessity for additional power capacity. In this district, however, there are eleven prospective hydro developments under consideration by the Bureau of Reclamation but not mentioned by the engineers in the Pick Plan. These would have an aggregate installed capacity of 342,000 kw.

Obviously the development of the above mentioned projects would create a tremendous surplus of power over and above all anticipated requirements for years to come in the areas affected.

In the Dakotas the present installed capacity is about 100,000 kw for each State. The annual kilowatt-hour sales range from 200,000,000 to 225,000,000 kilowatt hours. The five large main river dams are all located in the Dakotas. Proposed irrigation would require considerable additional power but it is evident that there is no present or anticipated demand in the future that could absorb the potentially huge blocks of power so far as that immediate area is concerned.

If this power capacity is actually developed, a market for it would of necessity have to be found in more populous regions. That points to long and expensive transmission facilities into the States of Minnesota, Iowa, Kansas and Missouri. All of these States now have adequate capacity. Additional capacity could also be developed locally to meet the normal growth of the load in those States more economically than to have a hydro-electric long distance transmission system superimposed on the existing systems.

The advocates of developing these large hydro power dams point out that cheap power will attract industry and population to the region. In a measure that is true. The population attracted will, however, be subtracted from some other section of the United States. They also apparently overlook the fact that six other river authorities are being advocated in other parts of the country which are expected to produce vast amounts of power.

Mr. C. W. Kellogg, President of the Edison Electric Institute, recently stated that the nation's peak load in 1944 was approximately 41,000,000 kw; that the total installed capacity was 50,500,000 kw which provided a reserve of 9,500,000 kw, or 23% above the maximum requirements. This in the year of the greatest use of electricity in the nation's history due largely to the huge power demands of the war effort. He further stated "The Federal Government, however, is moving toward further governmental expansion in the power business. A Billion Dollar Flood Bill, recently passed by Congress, provides for extensive power development in a number of dams in spite of the natural conflict between flood control which calls for normally empty reservoirs to impound flood waters, and power production which calls for full reservoirs to maintain power output. A number of these projects are primarily power projects and

incidentally navigation or flood control projects. Power installation at dams undertaken by the Federal Government, but not yet completed, plus those before the Congress would add about 11,000,000 kw of generating capacity, and generate an additional 55,000,000 kilowatt-hours compared with an existing power capacity and output at such dams of about half that much."

In the Summary of Costs, Benefits and Returns prepared by the Department of the Interior, it is stated that "Power Market studies throughout the basin have shown that markets will be available as fast as firm power is produced, assuming that a reasonable length of time is required to place all of the plants in operation. Net revenues from the sale of power are estimated to be large enough to repay the cost of all power features with interest at 3%, and provide a substantial surplus to other project costs. The power will have a value of $17,141,000 annually at full development, and that has been taken as a measure of its annual benefit."

The report does not give any indication as to what is meant by a reasonable time, nor does it explain how these hydro power projects are to be formed. Some hydro projects have a ratio of six to one between installed capacity and primary kilowatts.

Many of the proposed plans for the basin are based on the 1245 page Report of the Army Engineers of 1934 contained in House Document No. 238, 2nd Session of the 73rd Congress. On page 508 it states "The potential markets offering the most immediate possibilities are found in the growing industries of the St. Louis Metropolitan area and in the lead mines of southeastern Missouri. Power possibilities on the Casconade and Osage Rivers in Missouri are located within easy transmission distances thereof and are the logical source of a large part of the power supply. The ability of hydro power to compete with steam in this vicinity, despite the abundance of cheap coal in eastern Illinois, already has been demonstrated by the existing Bagnell Plant on the Osage River."

The last statement to the uninformed would seem quite conclusive, however, the fact is that Bagnell Dam is not at all competitive in cost with modern steam plants. Its value is entirely due to the fact that it can be used to control costly peaks on the St. Louis system. Anyone interested in the present power facilities in the area and those proposed are referred to Senate Document No. 191, 2d Session of the 78th Congress, pages 123 to 135. Page 131 shows a summary for the area drained exclusive of the States of Kansas and Missouri. This summary shows a grand total of installed generating capacity of 1,195,925 kilowatts as of Dec. 31, 1942, and a generation in the year 1941 of 4,081,588,000 kilowatt hours. Of the installed capacity 62% was privately owned and produced 80% of the total energy generated. Of the privately owned generating capacity 53% were fuel plants and of the publicly owned 51% were fuel plants. These figures will be altered by the transfer of in excess of 100,000 kw of capacity and 500,000,000 kilowatt hours of generation in Nebraska from private to public power.

The area west of the ninety-seventh meridian is largely interested in irrigation and securing water to restore the water table in the Dakotas. This area thinks it has a prior claim to the water in the basin and the advocates of navigation likewise believe they have established rights to the water and are opposed to its being directed for other purposes. The total average annual supply is estimated at 22,473,000 acre feet at Sioux City, Iowa. The engineers reporting to the Governors' Conference estimated the annual requirements for a nine foot channel would be 14,281,000 acre feet; that present and planned irrigation by the Bureau of Reclamation would require 6,800,000 acre feet, and that sanitation would require 1,364,000 acre feet. These total 22,445,000 acre feet, or just about one-tenth of one per cent less than the estimated average annual supply. It was on this basis, however, that the conflicting claims for the water were compromised. I will not discuss in this paper either navigation or flood control. My views on those features of the river development were rather fully set forth in an article appearing in the January 1944 issue of the *Public Service Magazine.*

The people in the areas served by the companies represented here today, it seems to me, should be as vitally interested in this irrigation program as they are in the proposed power development. According to the plan of the Bureau of Reclamation, as reported in Senate Document 191, 2nd Session of the 78th Congress, some 4,760,400 acres of new land are to be irrigated, and suplemental water is to be furnished to 547,000 additional acres. This acreage is in over one hundred locations in seven different states. This great acreage will yield crops probably worth $200,000,000 at present day values. If these 53,000 proposed farms are developed, the Bureau estimates it will increase the population in the area by 636,000 persons. These crops will have to find a market and these people will have to be brought in from somewhere. I am not familiar with the trends in other states, but in Missouri we have had a definite shrinkage in our farm population due largely to the difficulty of making satisfactory earnings in return for the farmers' hard labor. It does not require much imagination to see how these new compact irrigated areas would be able to form strong marketing organizations and outsell the less favorably situated high ground farmers now struggling to make a living. It is, therefore, not only possible but quite probable that many of the 636,000 new population in the new irrigated areas will be drawn from the farms of the lower river region with a resultant loss to these states of their farm population and income.

No one can object to the people in the states west of the ninety-seventh meridian desiring to improve their material wealth. However, since much of the great expense of the plan is to be paid out of taxes, such developments are proper subjects for the scrutiny of all the taxpayers. There are only about 50,000,000 acres in this nation that can, by the use of water, be brought into cultivation. In normal times, as has been repeatedly demonstrated, the nation's farm problem has been one of excess production. Such being the case, is it wise to add to this surplus by using up 10 per cent of the nation's land reserves? We hear on all sides the necessity of conserving our land in order that posterity may be fed. Posterity could be best served by withholding these dry acres until such time as the nation really needed to put them under cultivation. Many students, both within and without the government, are strongly of the opinion that public moneys could be better spent in holding the water where it falls as a check on floods and to prevent the terrific annual loss of material wealth as represented by the silt and dissolved minerals carried by our rivers into the sea. In this connection, I refer you to the report of the Water, Soils and Forestry Committee, as adopted by the Conservation Federation of Missouri at their Sixth Annual Convention, September 23 and 24, 1944.

The authorization of $400,000,000 for the Missouri Basin will insure, under the methods used in Congress to secure appropriations for a large number of

projects grouped in one bill, actual appropriations to carry out the plan step by step. It would seem proper that the public utilities, farm organization, taxpayers, and other interested parties see that these appropriations are in accordance with an actual need. Members of Congress are not only responsive to but welcome reliable information affecting public expenditures. The present enormous public debt should be a powerful factor in holding expenditures to projects of proven necessity. The expense of the necessary studies and reports to be presented to Congressional Committees, in the interest of an orderly and economic development of the plan, would be amply justified especially if it would result in preventing a useless excess of installed power capacity.

The advocates for an MVA authority sit in high places. They are resourceful and have superior facilities for publicity. If the various interests in the basin fail to cooperate, then MVA advocates may be able to persuade the Congress that an MVA is the only solution to bring about proper coordination. HR490 to authorize a Missouri Valley Authority has already been introduced in the present session of Congress by Representative Lemke of North Dakota. If an MVA is to be avoided, it would seem that membership of this industry collectively, if possible, should offer itself to the utilization to the fullest extent of such surplus power as may be developed. The economical development of these hydro stations will require interconnection with steam generating plants. This steam plant connection can be best furnished by the existing steam generating stations now being operated in the adjacent territory by the privately operated companies.

The Act authorizes the Secretary of War to sell surplus water but surplus electric power is to be delivered to the Secretary of the Interior to be sold under rate schedules approved by the Federal Power Commission. Preference in the sale of such power and energy shall be given to public bodies and cooperatives. These provisions place the private utili-

(*Continued on page* 100)

Price of Electricity and Cost of Living

Various Indexes Compared

LATEST indexes of cost of living, published by the U. S. Bureau of Labor Statistics, show the total of the classification entitled "Fuel, electricity and ice" at 109.9 of the 1935-39 average. This has given the impression that the price of electricity has risen. The facts are that the price of electricity has actually declined but the total of this group has been raised by higher prices of fuel and ice.

Up to the adoption of the Labor Bureau's revision of the index of the Cost of Living in 1935, it was the usual practice to follow the main table of the index numbers for the country as a whole with another showing the per cent decrease in the price of electricity in 32 cities since 1913. This enabled the reader to form his own opinion as to the responsibility for the rise in the main classification, then called "fuel and light." The present classification, called "fuel, electricity and ice," draws attention to electricity, but is no longer followed by the separate table showing its price index. When this was called to the Government's attention, A. F. Hinrichs, Acting Commissioner of Labor Statistics, wrote the Edison Electric Institute on August 5, 1943:

"We have frequently mentioned the stability of the direction of the utility rates series in our cost of living reports and did so in the latest reports. . . . We have long planned to prepare sub-indexes for a number of the component groups which are combined in our cost of living indexes as now presented, and only the shortage of clerical staff has prevented our carrying out this plan. An article will shortly appear in the Labor Review giving a number of these indexes. . . ."

Inasmuch as nothing has yet been published by the U. S. Department of Labor, the following table has been prepared, giving the actual changes in the price of electricity, the U. S. Department of Labor's Cost of Living indexes and the series published by the National Industrial Conference Board in which electricity has been shown separately. It is suggested that, wherever possible, the Conference Board's series be used, because the present trend of the price of electricity is definitely shown. By computation, the index number of electricity in December, 1939, was 71.1, indicating a present decrease of 4.2 points, or 6 per cent. On the other hand, coal has advanced from 84.9 in December, 1939, to 101 in December, 1944, a rise of 16.1 points, or 19 per cent.

COMPARISON OF VARIOUS INDEXES OF COST OF LIVING AND ELECTRICITY

U. S. DEPT. LABOR			NATIONAL INDUSTRIAL BOARD INDEX NO.'s (*b*)						EDISON ELECTRIC INSTITUTE			FEDERAL POWER COMMISSION		
Dec. 31 Year	*Cost of Living Index* (a)	*Fuel Elec. & Ice* (a)	*Cost of Living Total*	*Fuel & Light Total*	*Elec. and Gas*	*Electricity Alone*	*Gas Alone*	*Coal Alone*	*Average Cost to Consumer All Kwhrs Used* c.	*Index No.'s* (a)	(c)	*Average Price per Kwhr for Monthly Use of* 25 *Kwhr*	100 *Kwhr*	250 *Kwhr*
1944	127.0	109.9	105.7	95.8	...	66.9	94.5	...	3.51	79.5	40.4	Not Yet Available		
1943	124.4	109.5	103.9	94.9	...	67.2	94.6	...	3.60	81.3	41.4	5.3c.	3.8c.	2.8c.
1942	120.4	106.3	101.0	90.6	...	67.5	94.8	93.0	3.67	82.9	42.3	5.3c.	3.8c.	2.8c.
1941	110.5	104.1	93.4	90.3	85.9	...	...	92.5	3.73	84.3	42.9	5.4c.	3.8c.	2.8c.
1940	100.7	100.7	85.9	86.5	85.9	...	...	86.7	3.84	86.8	44.1	5.4c.	3.8c.	2.8c.
1939	99.6	99.9	85.3	85.6	87.1	(71.1)	...	84.9	4.00	90.4	46.0	5.4c.	3.9c.	2.8c.

Notes: (a) Index numbers are % ratios of the average of the years 1935-1939 inclusive.
(b) Ditto, 1923 base.
(c) Old Index on 1913 base. The Conference Board's weighting is as follows: Electricity 11.1%, Gas 22.2%, Coal, 66.7%. "Electricity" is the average price per kwhr, for 35 kwhr used per month in the 70 cities for which cost of living data is compiled.

A New Plan for Financing Appliance Installment Sales

By L. A. Mayo

Supervisor of Local Accounts, The Connecticut Light and Power Company, Hartford

SINCE 1922, The Connecticut Light and Power Company has been actively engaged in merchandising electric and gas appliances, selling them either on open accounts or on installment accounts. Appliance sales increased from a modest beginning to a prewar gross volume of about $2,000,000 annually. Wartime restrictions in appliance production, as well as in installment credit, resulted in the reduction of the number and amount of installment accounts on our books to the lowest point in many years, which makes this an opportune time to adopt a change in policy.

Few financial houses offered plans for underwriting installment accounts when the company started selling appliances. The funds had to be furnished by the company and, as the merchandising programs expanded, more and more funds had to be provided.

The company has always believed that furnishing funds for this purpose was a proper function of banks, but there were difficulties in bringing that about. It was desirable for the company to preserve all customer contacts. If the company had discounted the installment paper in the normal way, which could easily have been done, those contacts would have been removed and the contingent liability would have had to appear on the books of the company.

In cooperation with The Hartford-Connecticut Trust Company of Hartford, a new plan for financing appliance installment sales was developed. This bank, a leading one in the state, operates seven branches in our territory. The company will use the plan in its 27 district and branch offices, serving about 203,000 customers. These offices cover 107 communities served with electricity and 30 localities with gas, having a population of approximately 703,000 according to the 1940 Federal Census. The installment sales to be financed will include those to domestic, commercial and industrial customers, and similar sales made by dealers and discounted by the company.

What the New Plan Accomplishes

The plan has unique features which will achieve several highly desirable objectives and simplify its operation. The bank will purchase the accounts *without recourse,* so the company's balance sheet will not need to show a contingent liability. This feature is an innovation and gives the company a distinct advantage not generally provided for in other financing plans. It will take the company out of the financing field, with the bank assuming this function. Raising merchandise capital periodically will not be necessary as such funds will be automatically furnished when sales programs are expanded.

The company will retain full control of its merchandising policies and will be entirely free to develop this business. The company will act as the bank's agent, without compensation, in bookkeeping and collection matters, eliminating duplications in this work, which will result in a low operating cost for the plan. The company will retain the important advantage of dealing directly with its customers as heretofore, so that satisfactory relations will be continued.

Operation of Plan

The agreement executed between the company and the bank will cause only minor changes in the company's accounting procedures with no increase in expenses. The company will establish the installed prices of appliances, minimum and maximum terms, amount of financing charges, approve credits, and collect down payments. As sales are made they will be set up in the company's Accounts Receivable and billed to customers. At the end of the month, the bank will purchase *without recourse* the balances of all new agreements made that month, at face value less a small percentage as a reserve for uncollectible bills. This reserve will be the sole property of the bank and will be used to absorb bad debts.

The original sales agreements will be assigned and delivered to the bank, which will have five days to purchase or re-assign them to the company if the bank elects not to purchase. The company will be responsible for all payments collected for the bank until such funds have been paid to them. Payments collected will be deposited locally with company funds. All monthly collections will be paid to the bank not later than the tenth day of the next month. The company will pay to the bank, within five days from receipt of their invoice, a monthly financing or interest charge at a predetermined rate based upon the average daily balance outstanding on these accounts during the previous month.

Thereafter, until such agreements are paid or otherwise liquidated, the company will perform all bookkeeping work; show on its service bills the monthly installments due; answer customer questions; and follow collections. The company is authorized to take whatever collection action may be deemed advisable, including the institution of proceedings to repossess appliances.

The company is also authorized to determine when balances become uncollectible. The bank will reduce its outstanding balance by such amounts, charging them against the reserve. When six monthly installments are unpaid, the entire balance of those accounts will be presumed to be uncollectible. Obviously, it will be in the company's interest to minimize this possibility. The bank will be advised monthly of balances which have become six months delinquent. The company will remit to the bank all amounts received on accounts previously reported as uncollectible, which amounts will be credited by the bank to the reserve.

Quarterly reports will be furnished to the bank by the company, showing for each agreement its number, date, purchaser's name, amount paid by bank, balance due, amount delinquent if any, and the period of the delinquency. As the volume of accounts increases, preparing such reports might mean considerable work, but these operations will be simplified by the use of punched cards and tabulating machines.

In cases where it becomes necessary,

because of delinquency, to repossess appliances from customers, it will be done either by the company or by the bank at the company's option. If the company repossesses appliances and desires to own them for purposes of resale, it may do so by paying the bank the predetermined value of such appliances, as set forth in a formula in the contract, based upon the depreciated value of the appliances in question. Otherwise, the bank may repossess such appliances and own them and the company has nothing to do with it.

If requested, the bank agrees to sell the company for the amount of the unpaid balances any agreement it has purchased, returning the original agreement upon receipt of payment. The purpose of this provision is to enable the company to deal with its customers at all times in a manner best suited to maintain good public relations. Some customers will want to return appliances because they can no longer use them, and will wish to be relieved of the commitments made. Others will want to exchange appliances, before full payment, for larger or newer models. Then too, collection action may lead to new credit terms with customers before such time as six monthly installments are unpaid. For these reasons, the company has the right to purchase such balances from the bank and to re-sell them later under new agreements. The bank will also re-assign and deliver to the company the original agreements when accounts are paid in full or when they become uncollectible.

When discounts are allowed for full payments before maturity dates, these amounts will be absorbed by the company because the company benefits when such outstanding balances are paid, as it no longer has to pay a financing charge. Credits or adjustments allowed customers for policy reasons or because of defective appliances obviously must be absorbed by the company and not by the bank.

The company will furnish the bank such additional reports as may be required by the Bank Commissioner of Connecticut. The company will also furnish the bank, annually, a certificate from its public accountants showing the result of their examination of the balances, or a report concerning the efficiency of the company's system of interal control relating to such balances. The bank will be permitted to examine the records maintained by the company at any reasonable time. The agreement made between the company and the bank will be subject to review upon written request of either party. The agreement may be cancelled upon three months' written notice but, if cancelled, all terms and conditions shall remain in force with respect to transactions occurring prior to this cancellation date.

From this brief description of the plan, it will be noted that the bank will have little bookkeeping to perform, which enables the bank to name an attractive financing charge. The plan will be started at an early date and no difficulties are anticipated in its operation. This plan goes a long way toward solving one of the problems that has arisen in connection with the merchandising business, namely, the provision of funds to finance such transactions, which under the new plan will be furnished by the bank whose proper function it is. At the same time, it preserves for the company the contacts with its customers who will continue to do business in respect to sales with the company, the same as heretofore. The amount of bookkeeping and collection work to be done by the company will be practically the same as under the old arrangement whereby the company was required to furnish the funds.

Another Fire Insurance Rate Reduction Is Negotiated by Insurance Committees

A FIVE per cent reduction of fire insurance rates on certain types of electric and gas utilities' property has been recommended by the Central Traction and Lighting Bureau to constituent regional rating organizations, and will become effective upon adoption by the regional authorities.

The new rate reduction comes as a result of more or less continuous negotiations with the Central Bureau by the Edison Electric Institute Insurance Committee, J. H. Nickell, Chairman, in collaboration with the Insurance Committee of the American Gas Association and is the latest of several that have been achieved in the past two decades by the Insurance Committees through their representations to the Bureau.

Properties affected by the rate reduction are electric generating stations, electric car and trolley bus houses, yards and rolling stock, and coal, water and oil gas plants, and natural gas plants.

Reductions will be obtained through application of addenda to present schedules of member organizations of the Bureau. Specifically, the recommended addenda follows:

Electric Generating Stations Schedule:

Deduct 5% from the final rates (including floater rates) produced by this schedule. This credit to apply to both buildings and contents whether written under specific or blanket form, and to apply after any charge has been made for the Inherent Explosion Clause.

Electric Car and Trolley Bus Houses, Yards and Rolling Stock Schedule:

Deduct 5% from the final rates produced by this schedule. This credit to apply to buildings, contents and rolling stock rated under this schedule whether written under specific or blanket form.

Coal, Water and Oil Gas Plants Schedule:

Deduct 5% from the final rates produced by this schedule. This credit to apply to both buildings and contents whether written under specific or blanket form.

Natural Gas Plants Schedule:

Deduct 5% from the final rates produced by this schedule. This credit to apply to both buildings and contents whether written under specific or blanket form.

Missouri River Development

(*Continued from page* 98)

ties at a disadvantage, nevertheless, a thorough knowledge by Congress and the public plus an attitude of full cooperation on the part of the utilities could result in a sound plan of power development, and prevent a duplication of the waste and losses that have happened in the Tennessee Valley and in Nebraska.

I have previously mentioned private power companies purchasing excess power in Wyoming and from Fort Peck. The Northwestern Public Service Company which serves the James River Valley in the Dakotas has publicly indicated their intention to purchase excess power that may become available. They further pledge that any net savings realized through such purchase will be passed on to the consuming public. They rightfully point out that existing distribution systems should not be duplicated as that would be an economic waste. This constructive approach to the plan will win friends in the area and in Congress.

A plan for cooperation to become effective, however, must be worked out and agreed upon prior to the Congressional appropriations and not afterward as in all probability it would then be too late.

Post War Domestic Air Conditioning and Related Power System Distribution Problems

By J. W. Anderson
Philadelphia Electric Company

Presented before the Transmission and Distribution Committee, EEI, Pittsburg, Pa., Feb. 15, 1945

At the October, 1944, meeting of the Transmission and Distribution Committee, Pennsylvania Electric Association, T. H. Eakle, Consumer Research Engineer of the York Corporation, presented a picture of prospective post-war volume sales of domestic air conditioning and home freeze units, which, if it materializes, will result in major service problems for utility distribution engineers throughout the United States. This report will (1) summarize these national forecasts; (2) indicate the sizes and characteristics of some of the motors that apparently will be involved, from which data the power system distribution problem will be evident; (3) discuss some of the characteristics of domestic air conditioning load; and (4) since the problems involved are national in scope, recommend their study jointly by the Edison Electric Institute and the Air Conditioning and Refrigerating Machinery Association, Inc.

Post-War Market Forecasts

Pre-war sales of residential air conditioners (generally individual room coolers) attained a national volume in excess of 40,000 units. Available figures indicate the following:

1940— 5,682 units sold
1941—42,641 units sold

Various authorities of the air conditioning industry have made forecasts for the future and generally agree that sales in a very few years after the war should increase to six or eight times those of 1941, i.e., 200,000 to 300,000 units annually, or to somewhere around a $60,000,000 volume. One forecaster (apparently more conservative than others) makes the following predictions for the post-war period:

V plus 1	86,004 predicted sales
V plus 2	113,986 predicted sales
V plus 3	138,000 predicted sales
V plus 4	170,340 predicted sales
V plus 5	197,840 predicted sales
5 Year Total	706,170

He uses 13,500 as the minimum that will be sold the first year, based on ½ per cent of the families with an income of $5,000 or more, given in available statistics as 7.7 per cent of the 35,000,000 families in the United States. This method of market prediction could be used in any state or city where Census Bureau figures on income groups and numbers of families are available.

As to home freeze units, strong user acceptance is anticipated, even though local locker plants become generally available. Forecasts place the national market in excess of 300,000 units the first year, with probably 1,500,000 in the first three years, although these figures may be subject to radical revision by new models of home refrigerators with frozen food compartments and the growth of daily door-to-door delivery systems of frozen foods.

Motor Sizes

Information from six leading manufacturers of room coolers agree that room coolers of the future will be driven by ½ hp and ¾ hp 115-volt motors that need only to be plugged in to any convenient convenience outlet. There is no reason to believe that other manufacturers will not do likewise. Central plant air conditioners for entire homes may run to 2 hp or 3 hp with possibly 5 hp required for extremely large homes. For combination winter heating and summer cooling a 1/3 hp to ½ hp fan motor will also be required, together with the 1/6 hp or smaller oil burner motor. However, central plant conditioners are expected to involve special house wiring.

For home freeze units, it seems to be agreed that motors will be 115 volts, with ratings of 1/5 hp or 1/6 hp for 4 or 5 cubic feet of storage up to 1/3 hp for 15 cubic feet and ½ hp for 24 or 25 cubic feet.

Characteristics of Residential Air-Conditioning Load

Before discussing some of the operating characteristics of motors of this general type, it will be of interest to summarize some of the characteristics of residential air conditioning load as found by tests on a number of residential central plant installations on the Philadelphia Electric Company System. From these tests, Mr. Constantine Bary of that Company has made the following observations as applying to the average customer in a fully air conditioned home:

(1) The total diversified load with air conditioning is more than 3½ times that of the December load without air conditioning.

(2) The diversified peak load occurs on a high humidity, high temperature day at 7 p.m. clock time (6 p.m. standard time). At the time of the system evening peak (6 p.m. clock time), it is about 98 per cent of its absolute peak.

(3) The rated connected air conditioning load of the average residential customer may be expected to be about 3.65 kw, producing a non-coincident demand of 5.19 kw and a coincident or diversified demand of 3.72 kw. It is of interest to note that the air conditioner demand is 142 per cent of its rating.

(4) The annual energy consumption for the air conditioning load is 1538 kwhr, of which about 33 per cent is consumed in July, 50 per cent in July and August, and 84 per cent in the five months from May to September, inclusive.

(5) Thus the annual load factor is about 3.5 per cent based on non-coincident demand, and about 5 per cent based on coincident or diversified demand.

(6) The increment demand of the customer's total summer load with air conditioning over his winter (or December) load without air conditioning, is 4.65 kw for non-coincident demands, and 3.42 kw for coincident or diversified demands. Comparing these values with those shown in (3), it will be noted that about 10 per cent of the air conditioning demand in the summer is absorbed by the seasonal characteristics of the "remainder" load.

Fig. 1 shows comparative typical daily load curves for the average customer for a summer day with air conditioning and for a winter day without air conditioning.

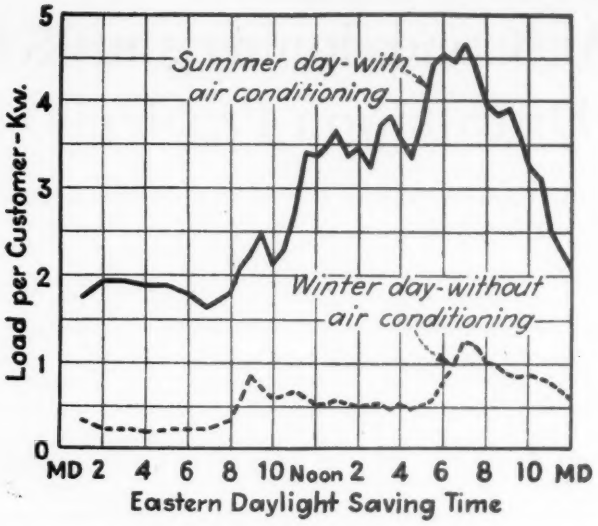


Fig. 1—Typical Weekday Load Curves for the Average Residential Customer

Individual room coolers will of course have somewhat different characteristics from the central plant conditioner. In the first place, the magnitude of the load will be considerably smaller, unless several units are installed for different rooms of the home (there are at least two cases in Philadelphia where two room coolers are in use). Second, individual coolers will in general be manually controlled. The effect of automatic control of air conditioning is evident in the summer day curve of Fig. 1 (91 per cent of the installations tested had automatic control). With manual control, the unit, if in a living room, will be started possibly in the early afternoon and allowed to run until late evening; in a bed room, it may be used for a few hours in the afternoon while baby naps, and then again most of the night, with or without some diversity of use with respect to a living room unit. Such unit or units will tend to give a block effect to the load curve, and it is doubtful if even a 1/3 hp room cooler with a demand of 140 per cent or more of its rating can be superimposed on a summer day load curve without increasing its peak to a value greater than the winter peak without it.

Thus certainly central plant conditioners, and probably individual room coolers will require additional investment in the distribution system to serve them. With the customary block residential rate, the revenue derived will generally come from the last steps of the rate and studies have shown that because of the extremely low annual diversified load factor of this equipment, revenue thus derived is inadequate to cover the costs in the distribution system (including substations and local transmission) and for production of the energy required. Should air conditioning load require generation and bulk power system investment, the inadequacy of return of course becomes considerably more glaring. It is understood that the EEI Rate Committee has this matter under advisement, as does the Association of Edison Illuminating Companies.

Table I—Characteristics of Fractional Horsepower Motors—115 Volts, 60 Cycles, 1725 RPM

A - FROM THE CATALOGUE OF A LEADING MANUFACTURER

Nameplate Rating - HP.	Split Phase - Special Service						Split Phase - General Purpose						Capacitor Start - General Purpose					
	Efficiency		Power Factor		Amperes		Efficiency		Power Factor		Amperes		Efficiency		Power Factor		Amperes	
	Full Load	1¼ Load	Full Load	1¼ Load	Full Load	Locked Rotor	Full Load	1¼ Load	Full Load	1¼ Load	Full Load	Locked Rotor	Full Load	1¼ Load	Full Load	1¼ Load	Full Load	Locked Rotor
1/6	50	53	54	57	4.0	26	63	64	69	73	2.6	20	62	63	60	66	3.0	16
1/4	57	58	62	65	4.8	38	65	64	74	79	3.4	23	65	65	66	70	4.0	21.5
1/3	64	65	62	67	5.6	41							66	67	67	72	5.0	31
1/2													69	70	69	74	7.2	43
3/4													70	70	70	73	10.4	58

B - FROM NEMA STANDARDS MG8-101 AND -102

Nameplate Rating HP.	Short Hour Service			General Purpose			Locked Rotor Current
	Efficiency	Power Factor	Apparent Efficiency	Efficiency	Power Factor	Apparent Efficiency	
1/6	46	52	27	56	56	36	20
1/4	51	56	32	61	59	41	23
1/3	54	58	36	63	61	44	31
1/2	58	60	38	65	63	47	45
3/4	61	62	42	67	65	49	61

NOTE: Values apply at rated voltage, frequency, and load. Efficiencies, power factors, and apparent efficiencies are minimum values and the product of efficiency and power factor cannot be less than apparent efficiency. Locked rotor currents are maximum values except for split phase motors used at present on washing machines and ironing machines.

Thus it appears that rate adjustments or other modifications must be devised before air conditioning loads can be added in large quantities to the system residential load without economic loss. What solution will be devised is unknown. But even at the expense of extra first cost and operating costs, many families will want the benefits and convenience of air conditioning and frozen foods in the home.

Motor Characteristics

The supply of 2 to 5 hp at 230 volts for a central plant home air conditioning system will often impose serious distribution problems. But, relatively, few such installations are expected. The bulk of the hundreds of thousands of sales anticipated by the refrigeration industry will be in the "packaged" units requiring electric service for 115-volt motors with nameplate ratings of 1/3 to ¾ hp. Probably only a very small percentage will be in the 1/3 hp group.

Evidence available indicates that numerous types of motors have been applied to these equipments, but not always the best for the purpose from the standpoint of starting characteristics and long-hour operation. In Table I, are shown various characteristics of fractional horsepower motors from the catalog of a leading motor manufacturer. These data are presented here only to show relative magnitudes of characteristics of several (but not all) types of motors that have or can be used. It will be noted that the most favorable motor in the nominal sizes proposed for room coolers will have locked rotor currents of 40 to 60 amperes. Should cheaper motors be used, even these currents will be exceeded. For completeness, data from NEMA Standards are also included. These are blanket standards applying to all types of motors.

It is not the intent to indicate that these are the motors that will necessarily be applied to future air conditioning units. The catalog data must be taken only to show relative characteristics among several types of motors; and list prices, which vary almost 2 to 1 for the motor types shown, might well be listed among the characteristics. The variations between types are significant in assessing possible future developments when more than 200 manufacturers of fractional horsepower motors and numerous manufacturers of compressor equipment operate in a highly competitive market.

For the purpose of this report, no attempt has been made to secure exhaustive data from the refrigeration industry on the characteristics of the motors they plan on using. Some data, however, have been made available by two large refrigeration manufacturers, on their post-war units. These data are tabulated above.

	Manufacturer A		*Manufacturer B*		
	½ hp. unit	*¾ hp. unit*	*Home Freezer*	*½ ton unit*	*¾ ton unit*
Volts	115	115	115	115	115
Running watts	700-875 (x)	1000-1250 (x)	545	785	1220
Running amperes	8.1-10.1 (x)	11.6-14.5 (x)	5.8	8.2	12.9
Running power factor	75%	75%	81.5%	83.5%	82.5%
Starting amperes	36.	50.	28.	35.	57.
Starting power factor	(y)	(y)	79%	81%	72%

(x) Maximum—occurring only under extreme temperatures.
(y) Not available but will use capacitor-start motors only.

As the foregoing table indicates, air conditioners must be considered a special motor application. In the first place, the motor is generally favorably situated with respect to cooling conditions and may be operated at substantial overload, insofar as nameplate is concerned. For example, tests on a 1/3 hp unit showed 585 watts input and on a ½ hp unit, 960 watts input, which after allowance for the small fan motor, represent a ratio of input to nameplate of 213 per cent and 235 per cent respectively. Another test, discussed below, gave 250 per cent. No published data indicate efficiencies so low as to account for these ratios. In the second place, compressor designers usually require starting and pull-up torque characteristics sufficient to bring the equipment up to speed under extremely unfavorable pressure and supply voltage conditions. These torque characteristics are obtained only at the expense of increased starting currents, and generally the starting current will approximate locked rotor current.

One manufacturer has announced the development of an unloader which can be applied to these units and which will materially reduce starting requirements. Until such a device is used universally, however, the room cooler motor must generally have both running and starting characteristics well beyond its nominal rating. It is significant that Manufacturer B in the table above has chosen to rate his equipment on a displacement basis rather than on a nominal motor nameplate which understates the demands of the device.

The Results of One Test

As a preview of what may be expected, some tests were made on a ½ hp window cooler installed on the lines of the Philadelphia Electric Company in 1941. The unit also includes a 1/15 hp fan motor.

The following characteristics were obtained, all values being read at the service entrance:

Starting voltage drop	5.5 volts
Starting current	34.4 amperes
Starting power factor	90. per cent
Running current	9.6 amperes
Running input	1035. watts
Running power factor	94. per cent

No complaints from the operation of this unit are on record. It is favorably situated on the secondary, being only about 200 feet (No. 6 wire) from a 40 kv-a transformer. This transformer supplied 125 customers, of which only 16 are on the same secondary branch as the air conditioner.

An attempt was made to secure a post-war ½ hp or ¾ hp unit from the development laboratories of a large manufacturer for tests at several locations on existing secondaries. It is to be regretted that such a unit could not be made available in time for this report. However, but little imagination is needed to project the future picture from the test situation summarized above.

The Future Problem

One unit—such as that tested—starting once or twice a day can and probably will operate for years without customer complaint from either starting or running conditions. But then project the proposed future industry sales of hundreds of thousands yearly over a period of years and establish saturation percentages as these sales occur—3, 5, 10, 15 per cent, and do not necessarily limit them to the $5,000 income group, based on locations where they have already been installed in Philadelphia. Then add the fact that a large proportion of them will have nominally ¾ hp motors with starting currents of at least 50 to 60 amperes. Then add the fact that with modern interiors, lighting is no longer confined to the hours of darkness, and the fact that the use of voltage-sensitive fluorescent lighting will also increase.

(*Continued on page* 106)

Impulse and Dielectric Strength Tests On Various Insulating Tapes

By G. B. McCabe
The Detroit Edison Company

Presented before the Transmission and Distribution Committee, EEI, Pittsburgh, Pa., Feb. 16, 1945

THIS investigation into the relative impulse strengths and 60-cycle dielectric strengths of various types of insulating tape is the outgrowth of some surge tests conducted on semi-stop joints in 3-conductor, 24-kv paper and lead cable.

Semi-stop joints are employed at the foot of vertical risers in 24-kv cable lines to retard or prevent the oil in the vertical cable from migrating into the horizontal sections. They are constructed at present by building up over the copper connectors and factory insulation a wall of hand-applied insulation of alternate layers of dry varnished-cambric tape and Vinsol compound brushed on hot. The lead sleeve is also filled with the Vinsol compound, which consists of 70 per cent Vinsol resin and 30 per cent castor oil.

Impulse tests on these semi-stop joints made with dry varnished-cambric tape revealed that they had only about 70 per cent of the surge strength of our standard 24-kv joints in which oil-immersed varnished-cambric tapes were employed.

It therefore appeared expedient to conduct an investigation and tests of the properties of insulating tapes to determine their possible influence in the finished joints.

Power-Factor and Moisture Tests on Black Varnished-Cambric Tapes

The black asphaltic-base varnished-cambric tape, which is nominally ¾ inch by 10 mil, is shipped to us in five different lengths or packages.

The four dry varnished-cambric tapes consist of the following:

A. 70—4-yard paraffin-dipped rolls shipped in a sealed metal container.

B. 10—4-yard paraffin-dipped rolls wrapped in heavy plain paper, then seven of these cylinders wrapped in an outer covering of the same plain paper, making 70 rolls in the package.

C. Same as (B) except that each plain wrapping paper is immersed in hot paraffin after application.

D. 20—36-yard paraffin-dipped rolls wrapped in plain paper.

E. The oil-immersed tape, which is in 4-yard rolls, is packed and shipped in a metal can of oil.

Preliminary tests made by dipping the tapes in 300 F paraffin indicated no extraneous moisture in the oil-immersed tape, but varying amounts of moisture in the dry tapes. Therefore, more exact tests of moisture content, dielectric strength, and power factor were conducted, with the results shown in Table I.

Accordingly, it was decided to conduct surge tests on individual specimens of these tapes; and, since the test setup was available, it appeared advisable to extend the tests to include several other insulating materials that have been and may be utilized for hand-applied taping.

Since 60-cycle test equipment was already installed adjacent to our surge generator, it also seemed appropriate to obtain dielectric strength values, as well, for these various taping materials, thus affording data on the impulse-dielectric strength ratios for the tapes.

TABLE I

Sample	A 4 yd. in Can	B 4 yd. Plain Paper	C 4 yd. Paraf. Paper	D 36 yd. Plain Paper	E OIVC
Moisture per cent (by weight)	0.8	1.6	0.8	1.0	0.2
Power factor per cent at 85° C and 50 volts/mil	14.0	16.9	11.7	13.6	10.9
Dielectric strength, volts/mil	1720	1570	1455	1530	1460

It will be noted that Tape B with the highest moisture content, which, by the way, was the tape employed in constructing the sample joints for impulse tests, had the highest power factor, whereas Tape E with the lowest percentage of moisture had the lowest power factor. However, it is of interest to note that Tape C had substantially the same power factor as Tape E, the oil-immersed, although its moisture content was four times as much as that of E.

There seems to be no tie-in between dielectric strength and power factor, for Tape A, which had a medium amount of moisture and the next to worst power factor, had the highest dielectric strength. Tape E, the oil-immersed tape, which had no extraneous moisture and the best power factor, had the next to the worst dielectric strength.

Impulse and 60-Cycle Dielectric Strength Tests on Tapes

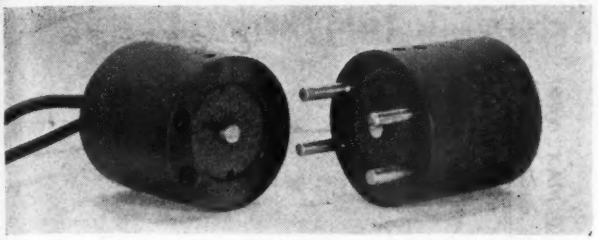
Although the above tests indicated that power factor is related to moisture content of the tapes, it does not necessarily follow that surge strength is similarly related.

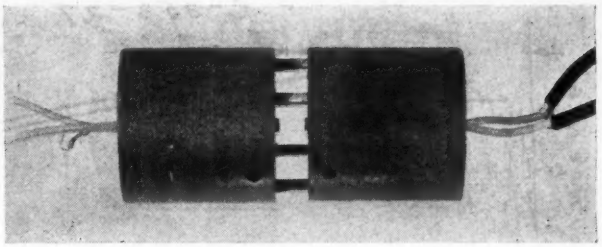
Materials Tested

Besides the five varieties, by the same maker, of black varnished-cambric tape, A to E, as described above, tests were conducted on two makes, F and G, of yellow varnished-cambric tape. Particular interest is being shown in yellow tape of this type, which contains a phenolic-base oil-resisting varnish, inasmuch as it would be a preferable tape for use in oil-filled apparatus and oil-impregnated cables, providing its physical and electrical properties are as satisfactory as those of the black tape.

The Dow-Corning Corporation has recently developed its No. 993 Silicone varnish, which, when used in combination with fiberglas tape, results in a flexible tape that can be operated at temperatures of 175 to 200 C. If this tape had adequate electrical and physical properties, as well, when employed as cable insulation, it holds forth possibilities of appreciable economies in reduced conductor and cable sizes. A sample of this Silicone varnish fiberglas tape was tested as Sample H.

Buna S (GRS) synthetic rubber has





Figs. 1 and 2—Tester for Breakdown Strength of Insulating Tapes

now supplanted natural rubber almost universally in our present wires and cables and in insulating tapes. Comparative tests were run on Sample L of GRS rubber and Sample J of natural rubber tape.

Several thermoplastic compounds have been developed which should find more extensive application in the field of electrical insulation. The thermoplastic tapes tested were as follows: Sample K—Polyethylene; Sample L—Polyvinyl butyral; Sample M—Vinylite; and Sample N—Koroseal.

Tests were conducted on a specimen of impregnated paper tape of normal density from a recent order of 24-kv impregnated paper and lead cable, thus affording a comparison of the various kinds of tape above with the factory insulation on our standard high-voltage cables. This specimen is Sample O.

Test Method and Equipment

The test cell employed for testing the individual tapes, which is shown in Figs. 1 and 2, is patterned on a similar cell recommended in the Appendix to ASTM Tentative Standards D-295-43T covering Tentative Methods for Testing Varnished Cloths and Varnished-Cloth Tapes Used in Electrical Insulation. It consists of a two-part bakelite cylinder with ¼-inch brass rod electrodes mounted axially in each half. These rods are held with a constant pressure by means of springs against the test specimen of tape, which is inserted between the two electrodes.

A synthetic rubber gasket surrounds each electrode so that, when the tape is in test position and the two halves of the test cylinder are locked together, the flashover path is no longer in air but is rather a creepage path between the rubber gasket and the surface of the tape. While satisfactory results were obtained with this cell on 60-cycle dielectric strength tests, however, the values obtained in the surge tests were so high that tracking across the bakelite face of the cylinder under the synthetic rubber gasket took place before puncture. Therefore, it was decided to modify the cell so that the tests could be conducted under oil instead of in air.

It is felt that the spring pressure of the electrodes against the tape specimen was sufficiently high that no oil could enter in between them during the short period of immersion necessary for an individual test.

Employing the impulse generator equipment, a negative 1½ by 40 standard wave was imposed upon the test specimens.

Due to irregularities in the various insulations, both in thickness and in inherent dielectric strength, it was impractical to obtain breakdowns either on the crest or on the tail of the impressed wave in most cases. It was the practice, therefore, to start the test on each sample at an impulse voltage somewhat less than the expected breakdown for the sample. The voltage was then increased to failure in steps of approximately 3 kv by using various taps on the potential divider, each wave being recorded on the film, as shown in Fig. 3.

If a breakdown occurred in less than a microsecond or before the wave front had started to bend over to form the crest, it was impossible to determine the actual breakdown value without applying a correction factor. Therefore, instead of applying such a more or less inaccurate correction factor, the highest value of withstand voltage, as recorded on the curve obtained just previously, was used. It will be noted in Fig. 3, which is from the test on black tape in a metal container, that withstand voltages of 34.5, 38, and 41 kv were attained in the three full-wave curves, while actual failure was recorded on the film in one-half microsecond at only 33 kv. The highest withstand voltage of 41 kv was, accordingly, taken as the surge strength for this tape.

If the time to breakdown was one microsecond or greater, in which case the curve had started to form the crest, the actual measured voltage was taken. In Fig. 4, which is from the test on yellow Tape F, failure occurred after one microsecond at 25 kv, which was, therefore, taken as the surge strength for this tape.

Test Results

The results of the tests are set up in Table II, which shows the thickness in mils, the impulse breakdown value, the AC breakdown value, and the impulse/AC ratio.

Discussion of Results

The following observations and conclusions were drawn from these tests:

1. More uniform and higher values of a-c dielectric strength of the five black

TABLE II

Sample	*Type of Tape*	*Thickness Mils*	*Breakdown, Volts/Mil Impulse*	*60-cycle AC*	*Ratio Impulse/AC*
A	Black V.C., in metal container	10.1	3620	1860	1.95
B	Black V.C., plain paper wrapped	10.6	3675	1885	1.95
C	Black V.C., paraffined paper wrapped	10.4	3490	1800	1.94
D	Black V.C., 36-yd. roll, plain paper	9.8	3770	1780	2.12
E	Black V.C., oil immersed	10.3	3470	1850	1.88
F	Yellow phenolic-base V.C.	8.8	2780	1535	1.81
G	Yellow phenolic-base V.C.	9.9	3430	1680	2.04
H	No. 993 Silicone varnished fiberglas	6.5	3015	1920	1.57
I	Synthetic rubber, Buna S (GRS)	26.5	1320	553	2.39
J	Natural rubber	26.0	1205	564	2.14
K	Polyethylene	4.0	7620	3230	2.36
L	Polyvinyl butyral	2.2	10240	5970	1.72
M	Vinylite	14.3	2115	1375	1.54
N	Koroseal	3.0	5620	3335	1.68
O	Impregnated paper	8.3	4080	1308	3.12

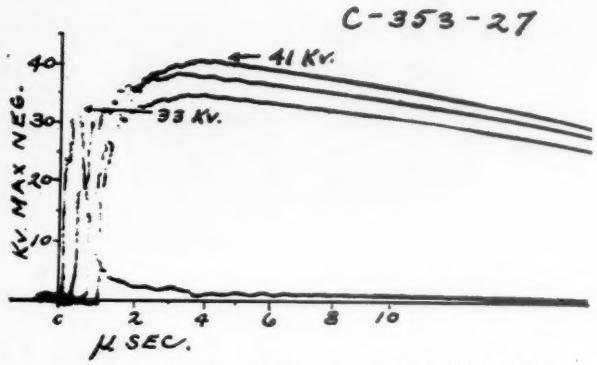


Fig. 3—Surge Strength of Dry Black V.C. Tape "A" in Cans.

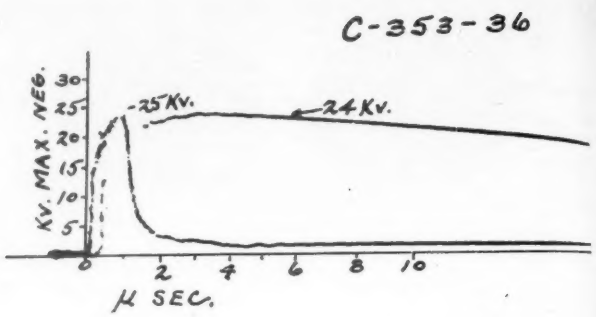


Fig. 4—Surge Strength of Yellow Bakelite Varnished Cambric Tape "F".

varnished-cambric tapes were obtained with the test cell immersed in oil than in air, due, it is believed, to the concentration of electric stress at the edge of the electrode being more effective in breaking down the specimen in air than in oil. The range of maximum to minimum values for the five tapes was of the order of only 5 per cent of the average when tested in oil compared to 15 per cent in air.

2. High moisture content in varnished-cambric tape apparently does not adversely affect the impulse or a-c dielectric strength, inasmuch as Tape B, the wettest of the five black tapes, had the highest dielectric strength, and the next highest surge strength. Tape E, the oil-immersed, which had a minimum content of moisture, had the lowest surge strength.

3. The yellow bakelie varnished-cambric tape, by Maker G, with whose products The Detroit Edison Company is more familiar than with those of Maker F, had surge and dielectric strengths of the same order as those of the oil-immersed black tape, which has been standard insulation for 24-kv joints. With further investigation of the physical and other electrical properties of these oil-insoluble yellow tapes, it may be found desirable to extend the use of such tapes to installations involving oil, which either may be contaminated by the usual black varnish or conversely may disintegrate the varnish of the black tapes.

4. The 60-cycle dielectric strength of the Silicone-varnished fiberglas tape was higher than that for any of the varnished-cambric tapes, although the surge strength was somewhat lower.

5. Synthetic rubber tape Buna S (GRS) is as good as the natural rubber tape which it supplanted, its dielectric strength being the same, and its surge strength being a little higher than that of the natural rubber.

6. Excepting the Vinylite, which was a somewhat abused sample of a rather thick tape, the thermoplastic tapes had very good impulse and dielectric properties, the Polyvinyl butyral having especially exceptional merit with a dielectric strength of 6000 volts per mil and a surge strength of over 10,000 volts per mil. Inasmuch as the unit stress increases for extra thin layers of a material, it may be that the thickness of only 2.2 mils may be somewhat responsible for these exceedingly high values of electric strength. Since both the Polyethylene and the Koroseal also had quite acceptable strengths, it is felt that further investigation into the other properties of these three thermoplastics is warranted to determine their suitabilities for possible applications on the system.

7. Contrary to expectations all of the tapes tested, except the natural and synthetic rubber tapes, had superior dielectric strengths to that of impregnated paper. The paper, however, had a surge strength slightly higher than the varnished-cambric tapes.

8. The impregnated paper tape had the highest impulse/AC ratio, namely 3.12, the ratios for the rubber tapes running about 2.25, those for the varnished-cambric tapes around 2.00 or slightly below, while the Silicone varnished fiberglas and the thermoplastics, excepting Polyethylene with a ratio of 2.36, had ratios ranging from 1.54 to 1.72.

9. It is hoped that the data contained in this report on surge and dielectric strengths of a variety of standard and recently developed insulating materials may serve as a stimulant for further investigations into the merits of the various materials to the end that many useful applications in electrical installations may be forthcoming.

Post War Problems

(*Continued from page* 103)

Then the fact that every customer on the transformer—whether he has an air conditioner or not—will see all or part of every flicker of every start of every air conditioner. Then add the fact that correction of secondary voltage regulation is frequently not only expensive but difficult to do physically.

The summation of all these considerations —and probably others are involved—point to a difficult future distribution problem which should be recognized now.

Summary and Recommendation

In view of the tremendous volume of sales which the refrigeration industry is preparing to foster and the ratings and demands of motors it is proposing to use, the conclusion is inescapable that the distribution engineer is expected, beginning early in the post-war period, to provide for starting and running hundreds of thousands nationally of 115-volt motors with locked rotor currents at least approaching 60 amperes. The seriousness of this situation needs no emphasis before this or any organization of distribution engineers.

The problem is national in scope and involves the mutual good of both the electric power industry and the refrigeration industry. Both industries are here to stay, and, as the situation now stands, the product of each will have serious adverse effects on the acceptance and use of the product of the other. It is recommended that the Edison Electric Institute, and the Air Conditioning and Refrigerating Machinery Association, Inc., both national bodies representing their respective industries, jointly study these problems to the end that these adverse effects will be minimized and controlled to the mutual benefit of both industries as well as the public at large.

In its preliminary work on this subject, the Transmission and Distribution Committee of the Pennsylvania Electric Association has had ample evidence that the co-operative effort proposed would be welcomed by the Air Conditioning and Refrigerating Machinery Association, Inc.

Industrial Lighting—A Symposium

on Incandescent, Fluorescent, and Cold Cathode Lighting

Presented before the Power Sales Conference, Missouri Valley Electric Association, Kansas City, Mo., Jan. 17, 1945

INTRODUCTION

By Thomas E. Graham
Oklahoma Gas & Electric Company

BREAKDOWN of utility revenue shows substantially that of the total, Industrial Revenue makes up around 30 per cent, leaving the remaining 70 per cent to be made up of residential, commercial, and public authority revenues. Monetarily speaking, this says that for every $30,000 of industrial revenue, an additional revenue of $70,000 is received from the residential, commercial, and public authority group and that every block of $30,000 industrial business therefore can be labeled as a $100,000 block of potential load.

To firm this up, it is reasoned that industrial employment makes up a goodly portion of the residential group; that the residential group supports commercial enterprise; and that public authority business is developed because industry has created a community with public houses, schools, street lights, etc. Thus, without industry, the other three groups —residential, commercial, and public authority, would fall far below the 70 per cent revenue level.

So, we say a thriving community exists because it has a well established and expanding industry, whose employees provide for the utility the goodly portion of residential revenue, through home use of its service, and prosperity to the community's stores, which in turn contribute to the utility's commercial load and revenues. And then expanding industry creates greater population that demands enlarged residential sections with street lights, water systems, schools and public buildings, from all of which the utility realizes increasing public authority revenues. We also say a backward community exists because all these things are just the reverse. It follows, then, that the four groups of utility revenues—industrial, residential, commercial, and public authority, are each interdependent on the others, with industrial lighting the main cornerstone around which the utility revenue is derived.

Now for industry to be successful it must turn out production that is a useful, attractive, production that can take its place in a competitive field and sell at an increasing volume, at a fair and reasonable price. This means high employee efficiency, which in turn means satisfied employees, working in bright, attractive surroundings and manning efficient tools and machines, made safe by scientific lighting and safeguards, to turn out production of the highest perfection and with the least number of rejects. Industry, in order to produce like this, must have Productive Industrial Lighting.

Just to see proportionate value of this industrial lighting, let us say it is 15 per cent of the $30,000 block of industrial revenue or $5,000. Recalling that a potential of $100,000 of total revenue is represented by the block of $30,000 of industrial revenue, it is seen that selling and keeping the $5,000 of industrial lighting business also means protecting or developing $100,000 in gross revenues.

Now this puts industrial lighting in a most important category and gets us up to the point of discussion.

Usually the power company's sales staff is composed of power salesmen, lighting salesmen, and so on. The power salesman is generally rated by the kilowatts of connected horsepower he signs up for the system, rather than by the small kw of industrial lighting load in the factories he serves. Because he has always been rated in this manner, he is prone to spend time on connected horsepower that probably could have been spent very profitably in convincing the factory owner of the advisability of properly lighting his manufacturing equipment and space.

The power salesman is held responsible for industrial customer contacts, but because the average power man is not a good lighting man he is not able always to recognize the lighting needs of the production line in his plants and thus be able to call on an experienced lighting man to advise and layout the proper lighting needed.

Your power sales committee sensed this possible condition, along with the importance of industrial lighting and reserved time on this program for papers by members of the Association well versed and experienced in light engineering. These papers follow.

INDUSTRIAL INCANDESCENT LIGHTING

By W. R. White
Nebraska Power and Light Company

DURING recent years, incandescent lighting has more or less reverted to the state of the forgotten man due to the lavish advertising heaped upon its new and glamorous brother, the long "F" tube. Even though the rotund incandescent bulb may have taken a back seat it has many outstanding features of usefulness and adaptability that will certainly prevent its passing into oblivion.

Edison's first successful incandescent lamp of 1.4 lumens per watt was completed in 1879. It has constantly been improved until it is today a very efficient and dependable light source. The carbon filament lamp of 1905 produced 4 lumens per watt. Gas filled lamps of 1913 produced 14 lumens per watt. The 1944 mazda lamp with its gas filled bulb and tungsten filament varies from 16 to 22 lumens per watt depending on size.

Construction and Operating Characteristics

An incandescent lamp consists mainly of a base, a glass bulb and a filament. It is quite rugged in construction and will stand considerable abuse in service. Due to its small size and light weight, large numbers of them can be stacked in a small space. They can be economically produced in large quantities and are inexpensive to buy. Most any one can screw one of them into a light socket.

Incandescent bulbs need no auxiliary equipment such as starters and ballasts. Freedom from the need of this extra apparatus materially reduces their initial

cost and the expense of installation and maintenance. Tubular-lamp fixtures, due to their shape and weight, are more difficult to hang than the single suspension incandescent fixture. Replacement of lamps is a simple operation but it seems that an expert is needed to remove and replace a tube type lamp, a starter, or a ballast. Different wattage lamps can be used in the same socket. With tubular lamps, the length of the tube usually changes with the wattage.

The efficiency of its incandescent white hot light source is not affected by temperature. Also the frequency of use, or, turning on and off doesn't materially shorten its life. It is a more stable source of light and is less affected by voltage fluctuations and operates at unity P.F. without the aid of capacitors and can be used equally well on either A.C. or D.C.

The light output of an incandescent bulb is easily controlled and directed which makes it almost universally adaptable to any use. It is the most practical source of light for floodlight and especially spotlight use. Due to its point source of illumination, its beams can be controlled and projected great distances.

Since it will start at any temperature, it is the most reliable light source for outdoor and cold storage use.

Universal Adaptability and Economic Application

This type of lighting is the only practical one suitable for explosion-proof, vapor-proof and dust-proof installations.

Incandescent lighting equipment is the feasible selection for small war plants where it is necessary that expansion costs be held to a minimum to allow the investment to be spread over a short period, or until new and more permanent buildings can be erected. Also, these materials are available without priority. For temporary occupancy, incandescent lighting offers quick, low cost illumination.

For merchandise display, incandescent lighting provides great flexibility. Small spotlights can be used either portable or stationary as may be required, and located in small out of the way places. Incandescent lighting is very desirable for use where the specular reflection of a small light source is desired.

Storerooms, recreation and game rooms that are occupied for short periods only, can be lighted more economically by incandescent fixtures. The installation costs would be low and the lamp life much greater since such installation would be turned on and off frequently.

Incandescent lighting is the only source practical for the illumination of outdoor sports area such as football fields, swimming pools, baseball diamonds and tennis courts.

High Bay Use and Balanced Lighting

Since this light source can be easily controlled and thereby projected in an intense small beam, or spread over a large area it is preferable for high bay use as is required in auditoriums, churches and some industrial plants.

High bay incandescent lighting is extensively used in large war plants. Also, in these industries, incandescent local lighting is installed in conjunction with general illumination. This combination is often referred to as the "Balanced Lighting Plant." Incandescent local lighting may be used in conjunction with any other type or combination of general lighting. This arrangement effects a substantial saving in initial investment as well as operating costs. Fewer fixtures are needed for general lighting and the equipment cost for local light application is low. The power used by the general lighting is lower, but its load factor is usually higher than if all illumination were general. The local lights can be turned off when the machine they serve is not in use.

Relighting and Repainting—Complementary

We are in the process of relighting and repainting the entire interior, including all machines and equipment, in our main generating station at 4th and Jones Streets in Omaha.

The turbine room is more than a block long, 60 feet wide and about 45 feet high. It is to be lighted by incandescent and mercury lamps installed in Holophane semi-concentrating reflectors. Holophane Fixture No. 691A1 is used with the incandescent lamps and No. 691AL with the mercury lights.

The lights are located on 21 foot centers and susended 40 feet from the floor. Twenty lamps are 1500 W incandescent —10-500 W incandescent and 10-400 Watt mercury. The 500 watt units are arranged to automatically switch over to D.C. in case of emergency. This lighting installation of about 3 watts per square foot will give approximately 30 F.C. maintained.

Indirect incandescent lighting will be used exclusively in the operating room. The indirect illumination will eliminate all glare and reflection from the faces of meters and instruments, and provide uniform illumination to all parts of the operating room. Although several methods of lighting were considered for the operating room, incandescent was chosen. One of the main factors influencing this choice was that incandescent lamps don't go out during severe voltage fluctuations and can be automatically and instantly changed over to D.C. for emergency operation. Dependable emergency lighting is one of the "musts" in an operating room.

The paint job in the turbine room is completed and has certainly effected a transformation in appearance. The new science of color dynamics was resorted to and as a result the turbine room has really had its face lifted. The East and West walls are painted a Sea Foam Green to soften the light admitted through the South and North windows. White applied to ceiling, including all overhead trusses and superstructure hides the clutter and relieves the feeling of overhead heaviness. North and South walls are coated by a suntone yellow to lighten up the dark spaces between the windows and break the monotony of the same color on all four walls.

A Pewter Gray floor gives a pleasing contrast with the walls, machines and portable tools and equipment. This should reduce accidents resulting from stumbling.

Turbines seem to operate equally as well in their pleasing coat of Vista Green as they did when wearing the conventional black. Throttle arms and valves stand out in Focal Yellow while other controls, levers, stairs and railing stand by in Focal Beige. The switch boxes adorned in their bright orange practically shout, "Here I am." The several colors provide excellent contrast between stationary machines, moving parts, stair rails, etc. The use of Vista Green on large areas such as turbines and Sea Foam Green on the walls affords operators the maximum amount of eye rest. The highly visible colors on levers and other control apparatus will help men to find them quickly.

The red fire fighting equipment stands out like a wood pecker's head and there is no excuse for a man mistaking the focal yellow crane hoist for the brilliant orange block and tackle.

The color schemes are to be followed in all parts of the generating station. Controls will be coated Focal Beige regardless of their location in the operating room, boiler room, turbine room or any other part of the plant.

Pittsburgh Plate Glass Company planned the color scheme and have taken pictures of the turbine room for use in their advertising in national magazines such as the *Saturday Evening Post*.

The men at the generating station regardless of their job are highly pleased by the new job of interior decorating.

The combined effect of the new scientific paint job and lighting installation has created a new and pleasing atmosphere that should promote good employee health and morale resulting in increased efficiency. Later, when conditions permit, we can sponsor generating station inspection trips and feature the turbine room as a show place.

Post-war lighting fixtures will in many instances contain both "F" and incandescent lamps so arranged as to utilize the desirable characteristics of both light sources. Incandescent lamps should have great post-war sales possibilities.

Summary

To summarize, incandescent lighting offers a low cost installation with equipment that is readily available without priority. The lamps and fixtures require a minimum of space—maintenance is an unimportant factor since starters, ballasts, etc., are not involved. Lamp replacement is very simple and empty sockets provide an immediate source of revenue since they can be filled by special sales campaigns. They can be universally used indoors and outdoors without regard to temperature. Frequent turning on and off doesn't affect lamp life. Incandescent lamps are less effected by voltage fluctuation and can be used with equal success on either A.C. or D.C. Its rays of light can be readily concentrated to produce a brilliant spot or widely diffused to flood an area as required. It is the only source of light practical for explosion, vapor, and dust proof service. Its flexibility of use alone or in conjunction with other light sources in any temperature and climate regardless of dust, vapor or explosive gases makes the incandescent lamp a universal and indispensable light source.

INDUSTRIAL FLUORESCENT LIGHTING

By R. F. Dice

Kansas Gas & Electric Company

FLUORESCENT lighting in our industrial plants has undoubtedly done more toward expediting the war needs than any other single item. With the application of this new "tool" lighting intensities in factories have soared to new levels that were considered impractical if not unattainable a few years ago. The results of this job have been greatly increased production, less spoilage and rejects, fewer accidents and improved employee morale.

While these accomplishments can be looked upon with some measure of pride, I don't believe there are any of us unwilling to admit certain weaknesses in most installations due primarily to restrictions on critical materials. The biggest headache has been the substitute materials used in reflectors. Warpage, discoloration and paint peeling have made it quite difficult to predict the final outcome on lighting recommendations and materially increased the work of the maintenance crew. At the moment this problem seems to be taken care of through recent WPB material releases and nearly all manufacturers are again supplying porcelain enameled steel reflectors on MRO orders rated AA1 and AA2.

The shortage of ballasts has been and still is another serious handicap. The tremendous demand for transformers for radar and other military uses is responsible for the ballast shortage and the Fixture Manufacturers themselves, as represented by their Industry Advisory Board, have asked WPB to continue L-78 in force as the fairest and most practical means of distributing the ballasts that are being made. Sequence starting has been used in some cases to overcome this situation, but there seems to be considerable difference of opinion as to the general acceptance of this type installation. One of the largest sequence starting jobs is in Oklahoma City and although difficulties were experienced at first, present operations are reported to be satisfactory. On this one job 12,000 ballasts were eliminated with a saving of $72,000. Critical material saved in ballasts alone amounted to 30,000 pounds of copper, 118,800 pounds of steel and 4140 pounds of aluminum. Since this plant installed a 460 volt Y distribution system throughout the plant, the 265 volts, necessary for sequence starting, was available without additional transformation. A 200 kw job of this type was installed in a Wichita plant and it has been quite satisfactory.

However, this job was installed where a 460-volt delta distribution system served the plant and it was necessary to install two 100 kva transformers and a separate lighting distribution system in order to obtain the proper voltage. In this case, the savings in money and critical materials was greatly reduced in comparison to the Oklahoma City job. In any case where sequence starting is used additional transformation and distribution are necessary for the operation of portable hand tools and supplementary lighting. It would therefore seem that this system for lighting is impractical except in new plants or old plants undergoing a complete rewiring and installing 460-volt Y distribution.

The advent and use of no blink or cut out type starters has done a great deal toward eliminating starter troubles. The principal advantages are, increased lamp and ballast life and decreased maintenance.

Maintenance schedules and procedure will vary with each plant depending on type of work being done, operating hours and accessibility of equipment. The larger installations in most cases utilize high bay lighting which requires the use of special portable scaffolds or cranes. In the interest of employee safety and uninterrupted production, one plant handles their maintenance work on Sundays. Schedules are governed by the type of work being done which in turn dictates the frequency of cleaning fixtures in order to maintain maximum light output. In the larger plants, operating almost continuously, extremely long lamp life has been noted due primarily to infrequent starting. This condition can be a decided disadvantage if permitted to go to the extreme and periodic lamp replacements (about every 4,000 burning hours) should be made, regardless of whether the lamp is burned out, in order to maintain a reasonable percentage of the initial lumen output. Recent test data, released by General Electric Company, on the effect of lamp life due to starting, along with lumen output after the various burning hours shows definitely the necessity of a lamp replacement schedule. Their test on the 40-watt T-12 and 100-watt T-17 lamps show the following results:

Lamp	Burning Hours Per Start	Rated Average Life (Hours)	% of Initial Lumens Per Watt at 70% of Rated Life
40 Watt T-12	3	2500	84%
	6	4000	76%
	12	6000	70%
100 Watt T-17	3	3000	78%
	6	4500	72%
	12	6500	69%

The statement is made that for most lighting services, the use of fluorescent lamps beyond 6500 hours cannot be economically justified.

With regard to lighting technique the larger factories in Wichita prefer general plant lighting of 30 footcandles, or better, with supplementary lighting as required for the job being done. One plant installed general plant lighting of from 35 to 40 footcandles and hoped to avoid the use of supplementary lighting. This was not entirely satisfactory and considerable supplementary lighting for jigs and the under surfaces of wing and tail assemblies has been installed. Tool and die shops have from 40 to 75 footcandles, drafting, engineering and lofting departments have from 50 to 100 footcandles and office lighting is from 25 footcandles on up. Plant lighting, in most cases, is with 4 feet and 5 feet R.L.M. reflector units using 40 watt and 100 watt lamps. Drafting rooms, engineering departments and offices, in most cases, use either trougher, flush mounting or pendant units with diffusing glass or egg crate louvers.

The foregoing remarks deal primarily with the larger new plants and old plants that completely remodeled or greatly improved their lighting at the start of the war. The large majority of the small sub-contract shops that have sprung up with the war are very poorly lighted and are certainly potential lighting customers. Most of these plants opened up over night and it was necessary to install anything that would make light so they could get under way. Some of these customers admittedly are in business for the duration and prefer to continue as they are and not spend any money. There are a number of those who expect to remain in business after the war who feel that used fluorescent fixtures will be available at 10c on the dollar and they will wait to install their lighting. Others are lighting conscious and are making fluorescent installations a section at a time as it can be done without too much interference with production. Still others have outgrown their original quarters and upon moving to a new location have made a good fluorescent installation. These customers will therefore constitute the bulk of our fluorescent lighting prospects for the remainder of the war and during the postwar period.

Fluorescent lighting has come into wide use so rapidly that it is only natural that there should be complaints. Some are due to a critical attitude by the public at large towards anything that is new but more are due to the installation of fixtures that do not shield the lamps properly for the prevention of glare. One of the most common complaints from workers is that the color of the light gives them a headache. Others advance the theory that the ultra violet emission from the lamps is injuring their eyes. Laboratory tests have proved that both of the above complaints are unfounded and the following statement by Dr. Samuel G. Hibben, Director of Applied Lighting, Lamp Division, Westinghouse Electric and Mfg. Co. sums up the answer to most complaints in a few words. "Nothing basically can be attributed to the fluorescent lamp in the way of eye injury except the faults of its careless usage. The greatest of these is the unshielded lamp because even though not much brighter than the typical diffusing globes of milk-glass, yet any such bare sources in the field of vision produce fatigue and annoyance. Industrial installations in particular with shallow reflectors or with open end reflectors that are hung parallel to the long axis of a room and thus in the probable line of vision, are especially troublesome. Glare conditions on the work probably may be worse where high footcandle intensities are hastily installed and where floor and

(*Continued on page* 111)

COLD CATHODE LIGHTING

By Marshall A. Havenhill

Kansas City Power and Light Company

NOTE: This paper is a brief description of a demonstration in the symposium of industrial lighting. The presentation was almost entirely demonstration so that those present could draw their own conclusions from their own experiences in the field, plus the demonstrations presented.

THE terms COLD CATHODE and HOT CATHODE have sprung up and become part of our vocabulary since the inception of fluorescent lighting and in order to discuss this subject at all we should have a definition of these terms as I fear we have been using them rather loosely. Webster's definitions are as follows:

Cathode—Green (down way)—The negative terminal of an electric source, or more strictly, the electrode by which the current leaves an electrolyte on its way back to the source.

Electrode—Either terminal of an electric source, especially, either of the conductors by which the current enters and leaves an electrolyte.

Electrolyte—A compound decomposible by an electric current. (See Ion.)

Ion—Small electrified particles into which the molecules of a substance are broken up under the action of an electric current. At low pressures the negative ions appear to be electrons. The positive ions, atoms minus an electron.

It is apparent that these definitions do not cover our general understanding of hot and cold cathode. Inasmuch, however, as the terms do refer in a measure to electronics we might look at the electronic definition of "cathode" which is:

Cathode
(Electronics)—Electron emission sources, no matter what type, are all called cathodes, since they act as the negative terminus for other electrodes found within vacuum tubes.

Now even with all of these definitions, it is rather difficult for us to get a clear understanding of the difference between hot and cold cathode. We really have to go into the operation of the present fluorescent lamp to see how these terms apply. In the fluorescent lamp we must have a material that fluoresces. We must have a source of ultra violet energy to cause this material to fluoresce. Sources of ultra violet energy at present are produced most easily by the medium of gas discharge in which gas atoms are bombarded by a stream of electrons. This is the principle used in fluorescent lamps. The gas used is mercury.

There are two common ways to get electron emission—one, thermionically in which a material is heated until it gives off electrons. This is commonly known as a hot cathode. The other method used is to produce an electron stream by a high voltage. When this is

done, it is not necessary to heat the cathode in order to make it emit electrons. An example of this is the corona discharge from the high voltage power line. Another, is the cold cathode fluorescent lamp or what has been commonly termed the neon sign.

Both the hot cathode and the voltage or cold cathode methods produce the electron stream and it makes no difference to fluorescent lamps which way they are produced. The major differentia between hot and cold cathode is now in who manufactures the fluorescent lamps —those manufactured by the neon sign companies are cold cathode; those manufactured by the incandescent lamp companies (General Electric, Westinghouse Electric & Mfg. Company, and Sylvania Electric Products, Inc.) are hot cathode.

The points that interest us in the power sales field and the points that are up to us naturally fall in the category of advantages and disadvantages of one type over the other.

Cold Cathode

Common outstanding advantages named and presented to us for *cold cathode* lighting are:

Advantages

Longer life.
Instant start.
Any length of tube.
Variable light entensity
Simplicity of circuit or wiring (series type).
Start and operate at any temperature.
Usually sold with maintenance.
Change light intensity at later date by merely changing size of transformer.

Disadvantages

Slightly lower efficiency than hot cathode.
Tube replacements must be secured from original supplier.

For *hot cathode* lighting the following comparisons would be made:

Advantages

Higher efficiency.
Lamp replacements from many dealers.

Disadvantages

Shorter life.
Slow starting.
Multiplicity of auxiliary equipment.
Inflexible unit due to standard lengths.

Fixtures must be changed or new ones added to increase light.

Will not start or operate at low temperatures.

Demonstrations were made of the cold cathode lamp, hot cathode type, and then they were operated together in series showing that they were all fluorescent lighting and the question of the cathode was of relatively little importance because today we can take all the advantages of the hot cathode lamp and we find that the manufacturers of the cold cathode lamps are able to incorporate them into their product. We also find that the manufacturers of the hot cathode lamps now have the same advantages of the cold cathode lamps. In other words, the advantages and disadvantages peculiar to fluorescent lighting itself are now shared practically equally between the so-called types of cathodes.

The writer, therefore, feels that the important thing to us as Utility people and power sales engineers is what can be done with fluorescent lighting and to use the series type if it is more advantageous; use the multi-type if it is more advantageous. We are given more opportunities now to exercise our engineering ability to bring to our customers the best in lighting that electricity can offer. In fact, if we really want to help our customers and the manufacturers of lighting equipment and lamps, we might even make suggestions at this meeting as to the desired characteristics we would like to have more readily available to us for industrial fluorescent lighting.

Who should know better than the power sales engineers what is needed for lighting as we are constantly in touch with the conditions in the field and this is where the lighting is used and operated.

NOTE: Demonstration was made operating—
10 Millimeter 4 ft. Neon tube
10 Millimeter gas gold fluorescent tube
10 Millimeter mercury vapor fluorescent tube
400 watt mercury element
100 watt fluorescent lamp
40 watt instant start fluorescent lamp
40 watt standard fluorescent lamp
64 in. slimline fluorescent lamp
all in series on one transformer. It was shown that these tubes would light and start instantly on any voltage between 25 and 130.

Conclusion

Following were the conclusions drawn by the writer:

1. The name CATHODE is relatively unimportant and believe that we should call all of these lamps "fluorescent."

2. It is apparent that the manufacturers of the so-called hot and cold cathode also have recognized the advantageous points of the other and are offering lamps with these advantages.

3. It might be that such organization as this could go on record suggesting to the manufacturers what we desire in lamps and auxiliaries.

4. Who should know what is needed in the lighting field more than the lighting people in the field?

Fluorescent Lighting

(*Continued from page* 110)

other surroundings are not carefully colored in accord. Most all complaints on fluorescent lighting are traceable to bad installation practice and not properly to any extraordinary qualities of the fluorescent light itself."

With all the industrial fluorescent lighting that has been installed during the past few years is there going to be much left to do after the war? A recent survey by the Westinghouse Lamp Division gives the following figures on the sale of industrial lighting equipment: 1944, $16 million; 1945, $9 million; 1946, $13 million; 1947, $21 million; 1948, $26 million. Another survey states that out of our 184,000 industrial plants 80 per cent will be suffering from lighting obsolescence and have to be revised after the war. A. K. Gaetjens of General Electric's lamp department estimates that 50 million fluorescent lighting fixtures will be required postwar by American industry with a potential added annual revenue of $100 million.

Those are big figures and may sound overly optimistic to you but if we discount them 50 per cent we still have a whale of a job ahead.

Will there be anything new for postwar applications? We now have the new 40 watt instant start lamp which will be a big help in numerous applications. The new slimline lamps have been announced for postwar. The world's largest exhibit of industrial and commercial lighting equipment is scheduled for April 19 to 23 at the Palmer House in Chicago and the present indications are that new and improved industrial units for postwar delivery will be announced.

From every angle it looks as though we were just getting started on this lighting job so let's get a little tighter hold and keep pitching.

Wisconsin Utilities Association Establishes Fellowship for Farm Research

By A. F. Herwig

Executive Secretary, Wisconsin Utility Association

A DREAM of some professors of the College of Agriculture of Wisconsin University that chore time on farms, now taking up from 50 to 55 per cent of a farmer's time, could be cut in half may be on the way to materialization.

For on March 21, the Board of Regents of the University approved a fellowship agreement with the Wisconsin Utilities Association providing for a four-year experimental project to ascertain the facts.

Professors believe that through modernization and simplification of barn layout as related to labor efficiency and through automatic electrical mechanization of work done on farms, production will be increased and that labor and investments will be reduced.

Professor F. W. Duffee, agricultural engineer, College of Agriculture, convinced representatives of the Association that an extensive research project, designed to dig out the facts, would prove beneficial to the state, the farmers, the university, the utility industry, and might do more to improve farming than has been done for decades.

The experimental project will be undertaken on a 144-acre farm about 5 miles from Madison as soon after April 1 this year as wartime emergency will permit. This new project follows through on other original research work conducted by the University twenty years ago, which pioneered rural electrification in Wisconsin under successive fellowships established by the Wisconsin Utilities Association and paved the way for present day farmer acceptance of electrification.

Under the fellowship agreement approved by the board of regents, the University is to receive $52,000 for expenses in conducting the research over a four-year period; not more than $46,000 is set up for the farm, experimental barns, equipment and livestock; and a maximum of $10,000 is provided for farm operating expenses.

Terms of the agreement stipulate a study of "economic use of electric light, heat and power for all phases of the dairy farmstead, with the purpose of saving labor, improving the quality of the milk produced, and reducing the costs of milk production."

University officials said the first phase of the investigation will include time-and-cost studies of methods dairy farmers now use in doing chores. With the records thus obtained for comparison, the next step will be to erect and remodel buildings, and test equipment, to determine how present methods can be improved.

Interest in the project is spurred by belief that a great many farmers will want to remodel or build dairy barns after the war, and will desire information as to how farm buildings can best be designed and arranged for labor-saving and efficient electrical chore doing, college of agriculture officials explained.

The research project will be conducted under the supervision of F. W. Duffee, university agricultural engineer, and I. W. Rupel, dairy husbandman. Duffee and Rupel will be assisted by a faculty advisory committee made up of P. E. McNall and W. W. Wilcox, agricultural economics department; B. A. Beach, veterinary science; S. A. Witzel, agricultural engineering; H. L. Ahlgren, agronomy; and R. J. Muckenhirn, soils.

Representatives of the Wisconsin Utilities Association, who negotiated the agreement with the College of Agriculture officials, included S. B. Sherman, association president and vice president and general manager, Wisconsin Gas & Electric Co., Racine; C. E. Kohlhepp, vice president and general manager, Wisconsin Public Service Corp., Milwaukee; G. C. Neff, president, Wisconsin Power & Light Co., Madison; G. V. Rork, president, Northern States Power Co., Eau Claire, and A. F. Herwig, Milwaukee, executive secretary of the Association.

The University will engage a farm manager, competent full-time research workers. Part-time research fellows will also be assigned to the study.

Professor Duffee stated the research work will likely proceed as follows:

1. The first step will be a thorough review of the H. B. White thesis, Recent Farm Work Simplification, and other studies on barn layout as related to labor efficiency.

2. The second step will be a study and analysis of the best designs in dairy barns today as related to mechanization and labor efficiency.

3. The third step will be to construct new barns and out buildings designed to:

a. Incorporate the maximum of electrically operated labor saving equipment.

b. The buildings so designed and constructed as to permit maximum amount of change with a minimum of expense so as to be able to make changes, for the purpose of studying various types of equipment and different arrangements.

c. The major part of the study will be applied to the conventional stanchion type of barn.

d. A one-story barn will probably be constructed, at least at first, as it will be easiest to change and cheaper to construct.

e. Possibly a short section of a barn can be used for some of the preliminary studies.

f. A grain storage and processing building will be constructed, equipped and located for maximum efficiency.

g. Grain handling and processing equipment will be studied.

h. Hay and bedding handling and feeding methods will be studied.

i. Manure handling equipment will be studied, additional equipment developed if necessary and installed.

j. A milk room will be constructed that incorporates the maximum of labor saving equipment.

EEI Publications

A catalog of all EEI publications is available upon request to

EDISON ELECTRIC INSTITUTE
420 Lexington Avenue, New York

Little Known Facts About Electricity That I Never Learned In College

By C. M. Ripley
General Electric Company

From a talk by Mr. Ripley

THE electrical industry is a young industry, and I can prove it! I was alive when Edison invented the first incandescent lamp so in just one lifetime, the electrical *manufacturing* industry (where I work, in Schenectady, New York) and the electric light and power industry (that lights your lamps and runs your motors) have spread all over the civilized world. And because both of these industries started in the U.S.A. and also because we Americans are hustlers, we Americans now use between one-third to one-half of all the electric power in the world!

Now because the electric power and the electric manufacturing industries are both so young, they literally bristle with little-known facts—some of them of quite a surprising nature. In the next twelve minutes I will review some of the little-known facts about electricity that I never learned in college. But first, let's start with something you do know:

When you buy electricity, you buy work—muscle work—not brain work. You can accurately and scientifically express a kilowatt hour directly in foot pounds. Many people, it is true, think that you must say "foot pounds per minute" or "foot pounds per second," but that is not correct. When you buy electricity you buy it by the kilowatt hour, and a kilowatt hour is 2,655,000 foot pounds. That is equal to the work of a man climbing to the top of the Cleveland Terminal Tower, 25 times! Whether you walk upstairs or run upstairs, the work is the same. Although it takes more POWER to *run* upstairs, the *work* is no more than when you walk up.

Another little-known fact about electricity is that a watt is 44¼ foot pounds per minute. That is a measure of power. If the grocery boy left 44 one-pound cans on your kitchen table and you wanted to put them on the bottom shelf of the cupboard one foot above the table, it would be a hard job for you to put those 44 one-pound cans up to one foot, in one minute, with one hand. If you put them up in half a minute, you would be exerting the power of two watts. If you put the cans up in two minutes, you would be exerting the power of one-half of one watt. But in either case, the *work* would be the same.

The work in one kilowatt hour is more work than a man can do in a day. Or putting it differently—a day of hard labor by a strong man is never as much work as the work in one kilowatt hour. Even an athlete, striving for fame, cannot in a whole long day do as much work as the work in four cents' worth of electricity.

At Niagara Falls, *ten tons* of water must make the drop in order to make one kilowatt hour. But in a modern steam power plant, one pound of coal will make one kilowatt hour. So you see, pound for pound, coal in modern power plants is 20,000 times as powerful as Niagara's water.

No man can make a kilowatt hour in a day. Many have tried to do it, but they have all failed miserably.

First, for instance, take the bicycle generator. We have made several of them. You climb on and peddle hard; that turns the generator attached to the back wheel and in that way you can light a 100 watt lamp for a little while. But we wanted an expert to try it. So one bicycle generator was taken down to Madison Square Garden in New York, while the six-day bicycle race was on. We have a fine photograph of the French champion, Mr. LeTournier, dressed in his racing suit, sitting on our bicycle, equipped with his special curved racing handle bars and rubber and steel toe clips to keep his feet from slipping off the pedals. And there he is making a desperate sprint. You can see the effort he makes, the tendons stand out in his neck and behind his knee. He burned a 100 watt lamp longer than anybody else did. Then he stepped off, breathless and we read the meter. It showed that he made 1/2000th of one kilowatt hour. He would have to get breathless 2000 times before he made 4c worth of electricity.

We figured it out, from that meter reading, that if he and his teammate had been able to keep up that sprint speed six days and six nights, the two together would have made seventy-eight cents worth of electricity that week! That's pretty poor pay for two internationally famous athletes in the prime of life and in the pink of condition.

And then the Army and the Navy have hand generators. There is a crank on each side, and you turn the cranks with both hands. You turn them 60 revolutions per minute; it makes 60 watts for radio messages from the jungle and from life boats and in fact any place, where there isn't any socket to plug into. The manufacturers in Erie, Pa., have sold 60,000 of them all over the world, and the overall efficiency from your muscle to the electric wire is almost 60 per cent—that is very high.

Well, I got hold of one of these and rigged it up in my office—clamped it onto a steamp pipe. I wired it up to a 60 watt lamp and sure enough lighted it with my own muscles. I invited my office neighbors to turn the cranks to see what it felt like to take 60 watts out of their breakfast and light that lamp with it. Many tried it, but none turned it longer than a minute. I remarked about that, and just then a strange voice spoke up behind me: "What will you pay me if I light the lamp five minutes?" I turned around and there stood a husky young porter that works in our building. "Come right in," I said, "and I'll pay you a dollar if you keep the lamp lighted for five minutes, $2.00 for ten minutes, $3.00 for fifteen minutes, etc. As long as you keep that light burning at normal brilliance, I will pay you at the rate of $12.00 an hour!"

His face lighted up, his coat came off, and he started turning the cranks and lighting the lamp. He was smiling and confident—*when he started in.* But in just 13 minutes he quit, dripping with perspiration, utterly exhausted and pant-

ing for breath. I paid him $2.60 and said, "Why didn't you keep it up? $12.00 an hour is higher pay than that you get moving furniture or washing windows." And he gasped, "The money wasn't worth the work!"

And what was the work? Work is power multiplied by time. The power he delivered to the lamp was 60 watts. The time which he delivered it was 13 minutes. So when you multiply them, you see the work he did was just a few watt minutes. It is easy to see what a pitifully small fraction that is of a kilowatt hour, which is 1000 watt *hours!*

Now, let's continue our investigation of little known facts about electricity. You do know, of course, that electricity is divisible into light and power and heat and electronics. But how about the degree of light which the electric lighting industry has developed? Up in an airplane, you can read a newspaper by the light of an Army or Navy searchlight six miles away on the surface. And that light is divisible all the way down into the little "grain of wheatlamp" that the doctor puts down your throat to help him see. And electric power is divisible all the way from the huge motors that run the steel and cement mills and locomotives down to that popular little motor that runs the dentist's drill. Some motors are hardly larger than a spool of thread.

Electric heat is divisible all the way down from the terrific temperatures of the electric furnaces to the gentle warmth of the heating pad that relieves baby's earache. The heating pad, of course, developed into the electric blanket and the electric blanket developed into electrically heated clothing, coats, trousers, gloves and shoes worn by our pilots when they are six miles up in the sky where it is eternal winter—60 degrees below zero even in the summer.

Did you know, too, that a pilot also wears electrically heated goggles? They protect his eyes from the wind and the cold in those ghostly regions of the sky where grease freezes and metals shrink and men need protection from the wind and the cold. The heating wires run back and forth inside the glass in the goggles, much like the filament in your toaster. This prevents the goggles from becoming frosted over with freezing fog that blinds the pilot. The amount of electric power needed to keep a six foot pilot warm from his eyebrows down to his big toes is about 280 watts or about half of the power needed to toast a slice of bread.

Perhaps you have never stopped to think that electric light is flameless light, electric power is flameless power, and electric heat is flameless heat. In an airplane, 25,000 feet up, a candle sputters. It goes out at 33,000 feet. But electric heat is just the same six miles up as it is at sea level—it is independent of the atmosphere—there is no combustion. It gives heat without needing any air.

And besides being divisible and flameless, electricity is versatile. A horse can pull a load but he cannot vacuum sweep your floor. (Electricity does both.) You can refrigerate with ice, but it will not run an X-ray machine at the hospital. You can cook with several different kinds of fuels, but not one of them will run your radio. So you see, you can load all of these different jobs on electricity's shoulders and when you do, you will find that he is Jack of all trades and master of *all!*

Did you know, too, that in American industry, there are 6½ hp of electric motors for every factory worker, an average of 6½ hp for the 6 foot man and for the 5 foot girl. Now the 6½ hp is 4,800 watts. Strong men, however, are only able to exert 35 watts and keep it up all day. That is the power of a strong man—35 watts throughout the day at the average task. Well you see, the factory boss is providing for the worker 4,800 watts or 140 times as much power as the man himself possesses. So his output is increased at least 140 fold. And perhaps a five foot girl's output is increased 280 fold because the fair sex is the weaker sex. That's why girls can work in factories now. They don't have to pull on heavy chains, or throw ponderous levers, or turn iron cranks, or lift heavy loads. No, they just sit there, and push buttons, and step on pedals. Few girls in factories do as much physical work nowadays as waitresses in restaurants or chambermaids in hotels.

Another fact—this war has catapulted America into a new metallurgical age. When I was a baby they finished the Washington monument and at the top they put a little pyramid of aluminum 6 inches by 6 inches by 9 inches high. It was the biggest aluminum casting in the world—it weighed 26 ounces. It is still there and in good condition, I am told. Then, aluminum was a laboratory curiosity, it was a museum specimen, and it cost around $100 a pound.

When I went to grade school at Indianapolis, aluminum cost $10 per pound and there wasn't any in our middle-class homes. When I went to college at Purdue, aluminum cost $1.50 a pound and they told me some of it was made the new electric way. When I got my present job with General Electric Company, aluminum sold for 28c a pound and most of it was made the electric way. Now it costs 15c a pound and *all* of it is made the electric way. Now the electric way is the only way in which aluminum and magnesium can be made quickly, and cheaply, and in vast quantities. There *is no other way* to make these wonderful new metals, unknown in former generations and unused in former wars, yet vital in this war right now!

Do you wonder that—as I look at the developments in electricity which have all taken place in my lifetime—I consider the sum total of all these changes the most remarkable in the industrial history of mankind?

RECENT EEI PUBLICATIONS

CABLE OPERATION—1942

EEI Publication No. L1—A Joint Report of Committee on Power Distribution, Association of Edison Illuminating Companies and Transmission and Distribution Committee, Edison Electric Institute. Price to members and their employees, 50c.; non-members, $1.25; foreign, $1.35.

CONTINUING the policy initiated with the cable operation report published last year, the present report combines the essential features of the cable operation studies previously carried on separately by the Association of Edison Illuminating Companies and Edison Electric Institute Committees. The number of contributors this year (16) is one less than that reported last year.

The total cable trouble rate for paper-insulated, duct lay cable has decreased from a 3-year level of 6.9 to 5.8 in 1942.

The joint trouble or component rates dropped from a 5-year average of 1.7 to 1.3 in 1942.

The total trouble rate for potheads decreased from 2.9 to 1.9, continuing the downward trend of the past five years.

Electrical Hazards and High Tension Fires

By A. G. Harrison

The author of this paper, an employee of the Philadelphia Electric Company, is Assistant Fire Chief of a Volunteer Fire Department in a suburb of Philadelphia. The paper was originally presented at a meeting of the Pennsylvania Fireman's Training Conference. It contains much sound advice that should be of interest not only to volunteer fire organizations but to many operating officials and field men of electric utility companies as well.

SOME years ago when an alarm was received it was probably a class "A" fire, of large or small proportions, and it was a case of getting water in action as soon as possible. So routine were some of the fires of the past, that I have been told an old time Chief could tell whose place was burning by the smell of the smoke. Today, however, that is all changed, we do not know what to expect when the gong sounds. We have hazards, such as oil, gas, chemical, and electrical. It is the latter hazard that I shall discuss today.

Electrical hazards are not as terrifying as they sound. We simply must know what to do, and when to do it, and to whom to look for supervision and guidance. If it is a motor in a factory, we would simply shut off the power and use a vaporizing type of extinguisher. But, if it is a small vault or substation and adjacent equipment which is indoors, we must treat it with respect. We not only have an electrical fire, we have oil also. Most plants with large power equipment have an operator, and he should be on hand to discontinue the electricity; in his absence, the trouble dispatcher of the local utility company should be notified, and a trouble shooter should be dispatched. In most cities and towns the trouble shooter responds to all alarms.

Cooling is the best method of controlling electrical fires. If oil has boiled over, then we must look to foam as the solution to that portion of the fire. If there is a drain in the vault, well and good, oil will not burn in the drain. The vault should have a curb to keep the oil in the vault. Generally speaking, after the power is off, the fire is of short duration, except when the oil has ignited.

Private outdoor type substations are not a serious problem. If we cool the transformer we probably can stop the oil from igniting. Water in spray is best and is considered safe at certain distances on live equipment, which I shall discuss later. Some private substations reduce power from 4000-2300 volts to 440-220 volts. I would suggest that water be applied to de-energized equipment. When necessary to extinguish live equipment, use carbon tetrachloride, CO_2 or dry powder. In using portable equipment care must be used so as not to touch live parts.

If carbon tetrachloride is used on indoor vaults the gas mask should be used as a safeguard against the phosgene fumes.

Outdoor substations of utilities companies on their transmission and distribution lines offer quite a problem to firemen. Extremely high voltages are used and dangerous equipment is usually grouped on the ground with limited space, and the movement of fire equipment is hazardous. During war time it is sometimes impossible to isolate a station unless the fire is of major proportions. In that case, we must fight the fire in a restricted area. This is where we firemen must be guided by someone familiar with the conditions. Substations are listed as attended and un-attended substations. If we were called to an unattended station we could do no more than protect exposures, and wait for a trouble shooter from the trouble dispatchers office of the local utility. He then would advise us if we can be of service. It is well for all chiefs to know who your local trouble dispatcher is. I am sure he would welcome your cooperation.

The large attended stations are really power plants, except power is not generated there. It has transformers, lightning arresters, voltage regulators, switchgear, converters and other electrical equipment. Transil oil of a high flash point 295 deg. is used to keep the transformers and switches cool. Oil also breaks the arc in oil switches.

Sometimes these oil switches break down and are a cause of an electrical fire. Most utilities maintain excellent fire control equipment and the station operators are trained to use it. Sometimes at station fires an outsider will pull a box before the operator can send for special equipment. We must remember the operator has lots to do before he sounds an outside alarm, he has switching to do, so that you and I will not be out of light. But if a box is pulled we cannot run into that station to extinguish a fire, we would lose too many men. Remember this, the station operator has had years of experience before he is put in charge, so you can't expect us firemen to have all that knowledge at our command instantly. We can, however, get in touch with the operator in charge and he will advise us if we can be of assistance, and will make our work safe. He will welcome your cooperation.

The outdoor portion of substations consist mostly of transformers and switchgear. Most transformers are oil cooled and sometimes catch fire from mechanical breakdown and lightning or other elements. The oil must get quite hot to boil over, however, the radiators may rupture or the conservator tank overflow. Then we have an oil fire. The current should be cut off on the transformer involved, and two or three fog nozzles should be put to use to surround the transformer and cool the case. The streams should be directed to the base and extinguish any fire on the ground and work up gradually until the fire loses some of its fury and then one or two sweeps across the top should extinguish that part of the fire. After the first is knocked down, stand by for flashbacks. It must be remembered this work is done under supervision of the man in charge of the station. We must consider and treat all electric equipment as being alive. Never take a chance. We must keep our minds clear and use men that can be depended upon to do such hazardous work.

In war time stations cannot be shut down, and we must work in confined locations.

Some transformers are very large and contain over 3000 gallons of transil oil, which has a very high flash point 295

deg. Our problem is to keep the oil in the transformer case the same as a tank truck, or car. By cooling, we may be able to do that, and also stop the spread of the fire to adjacent equipment which is vitally important to keep operating.

I feel this roughly covers utility stations and equipment. Our next problem is fires along the highway where high-tension lines may be a menace. It seems wherever there is a large fire, there is also high voltage wires to contend with, and as water is always used it becomes a problem for us firemen, and one more headache for the Chief. Some authorities claim it is safe to use hose streams on hot lines up to a certain distance. I shall quote a few:

1—The Union Electric Company, of St. Louis, made tests with fog nozzles from 6 to 10 feet, on wires carrying voltages from 70,000 to 144,000 volts, and not enough current was registered on the instruments to be felt by man.

2—The National Board of Fire Underwriters in 1939 claim safe distances from 6 feet, for 1,100 volts, to 30 feet for 33,000 volts.

3—The Pennsylvania Railroad does not want anything within 9 feet of their lines. They do not quote any safety rule for use of water on their lines.

4—The Philadelphia Electric claim streams should not be closer than 10 feet to their lines.

It is to be understood these distances are the distances the play pipe is from the lines. I endeavored to find someone who has had the actual experience of playing water on high voltage lines, but up to now, have been unable to do so. Personally, I do not recommend it at this time. I do prefer spray, or so-called fog over solid streams. I do not have any fear on low voltages, nor am I afraid of spray carried over wires by wind.

There is an easy way to determine high and low voltages. The higher the voltage, the larger the insulators. 66,000 volts is probably the highest carried on poles on the highway. Higher voltages are carried on towers or wooden poles over a private right-of-way.. The regular distribution circuits found on streets have a small insulator about the size of your hand. This voltage will run from 2300 to 4000 volts. The voltage of wires, from the lowest position on the pole, will be as follows:

110-220 Volts — Secondary residential and commercial lighting and small power.
220-440 Volts—Industrial power.
2,300-4,000 Volts—Primary distribution.
13,200 Volts—Substation to substation distribution.
33,000 Volts—Transmission.
66,000 Volts—Transmission.
110,000 Volts—Transmission.
220,000 Volts—Transmission.

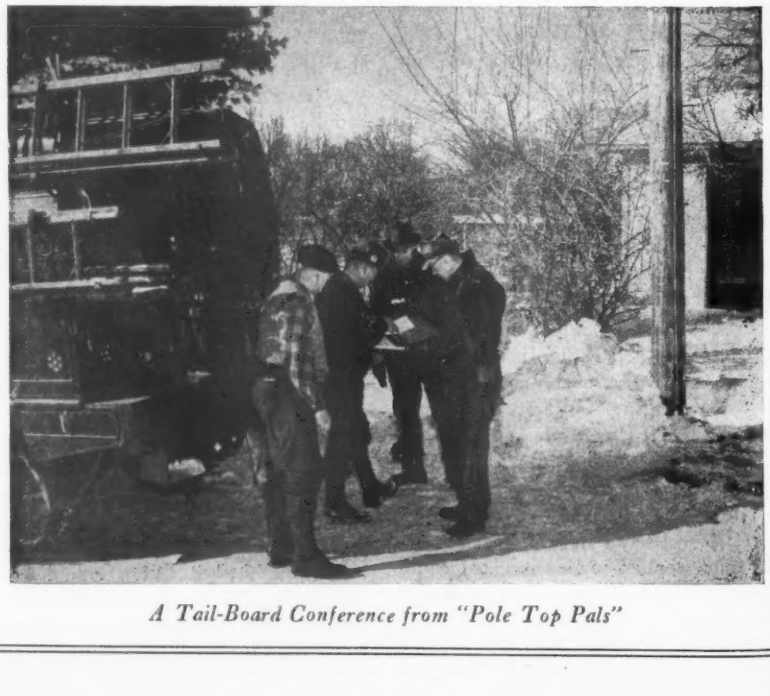
If a line is near a fire and it inter-

Accident Prevention Committee Announces New Safety Film

The Accident Prevention Committee of the Edison Electric Institute announces the production of a sound-slide film entitled "Pole Top Pals" by its sub-committee on Visual Education. "Pole Top Pals" was produced under the direction of Mr. E. C. Rue, Assistant Superintendent, Transmission & Distribution, Boston Edison Company, in cooperation with the Liberty Mutual Insurance Company. It is the first of a series of sound-slide films to be produced by the committee, dealing with safe practices in the electric utility industry.

This sound-slide film emphasizes the importance of planning the job and taking proper safety precautions in the execution of work on poles. Although construction details and work methods may be quite different in the companies who will show this film from those depicted, the fundamentals of safe procedure will be the same and much value will come out of discussion centering around such differences as will be observed.

"Pole Top Pals" may be ordered direct from the Edison Electric Institute, 420 Lexington Ave., New York 17. The price is $10.00.



A Tail-Board Conference from "Pole Top Pals"

feres with the Fire Department contact the local trouble dispatcher of your utility, and he will have the line cleared and notify you. If the Pennsylvania Lines are near, call the nearest Power Director, and he will clear that section, and dispatch a man to that area. As I mentioned earlier, a trouble shooter responds to all alarms in our larger cities and towns.

In working around lines, we must be very careful with other fire equipment, other than hose lines. Ladders must be handled with care. Metal ladders must not come in contact with live wires. If an aerial ladder is used near wires, it is well to jump on and off the truck because the tires insulate the ladder, and a man stepping on the truck would complete the circuit if the ladder was touching a live wire. It is well to consider all wires as live, one never knows but what a wire would fall at some other location at the fire and energize the supposedly dead one.

A word of caution is needed regarding electrical fires and accidents. There is more danger stepping in water charged by fallen wires than by playing a stream against an overhead wire. We cannot depend on boots, as they contain carbon that may permit the passage of current. If rubber gloves are used they must be in perfect condition, a small pin hole will make them defective. Gloves should be carefully stored and protected from excessive heat. They should be tested before wearing for leaks by holding wrist end of glove and twirling until glove is filled with air. With the wrist opening closed, the air should not escape through the glove.

If a victim has been caught on a live wire his rescue is dangerous for the rescuer. The current should be cut off, if it can be done soon, but to avoid fatal injury to the victim, other methods will have to be employed.

1—Wear rubber gloves and use rubber boots.

2—Stand on dry wood, or other insulating material.

3—Throw a crowbar across the line from source of supply, to ground as much of the current as possible.

4—Do not touch the victim with bare hands.

5—Start artificial respiration immediately, and don't give up hope.

Gentlemen, that seems to be a rough outline of what to expect around lines on the highway, and in conclusion, I want to leave these thoughts with you.

1—Know your electrical hazards.

2—Know the man in charge of electrical equipment in our large industries.

3—Know your local utility trouble dispatcher, and your railroad Power Director.

4—Protect Exposures.

5—Be careful of live equipment adjacent to piece on fire.

6—Keep a clear head.

7—Think first, then act.

8—Cooling is half the battle.

9—Keep oil in transformers.

10—Do not touch live equipment with portable extinguishers.

11—Take advice of station operators, or trouble shooters. They will protect your life. I do not know of any utility that will sacrifice a life to save a piece of equipment.

12—Take your time and do not rush unnecessarily.

Laura McCall Award for Home Service Activities

The Terms and Conditions of the Laura McCall Award administered for a number of years through the Edison Electric Institute, and the Merit Ratings which serve as a guide to the Judges, have been changed somewhat to conform to the general situation existing in the contest year 1944. The time of filing has been changed from April 1 to May 15. The time of presentation of prizes to the winners will be announced later but it is expected to be about July 1, 1945.

The Laura McCall Award consists of an Engraved Plaque, four Illuminated Parchments and a total of $400 in prizes offered to the private utility operating companies and to individuals in those companies who have made during the calendar year 1944 the most outstanding contribution to the war effort through participation in the 1944 war-time program of food conservation and preservation, thereby protecting and improving the health of our civilian population; in emphasizing the importance of the care, maintenance and use of electrical household equipment; and in general advancing the benefits of efficient electrical living in the homes.

Prizes

First Prize—To the Home Service Department—a Plaque on which the name of the winning department and company will be engraved each year. The original Plaque will remain in the possession of the winning department for one year. A duplicate of the Plaque will be presented to the winning department for permanent ownership. To the Home Service Director or Directing Head of the Home Service Department an individual prize of $150 in War Bonds and Stamps is to be awarded.

Second Prize — To the Department — a framed Illuminated Parchment for permanent possession; to the Director or Directing head, $100 in War Bonds and Stamps.

Third Prize — To the Department — a framed Illuminated Parchment for permanent possession; to the Director or Directing Head, $75 in War Bonds and Stamps.

Fourth Prize — To the Department — a framed Illuminated Parchment for permanent possession; to the Director or Directing Head, $50 in War Bonds and Stamps.

Fifth Prize — To the Department — a framed Illuminated Parchment for permanent possession; to the Director or Directing Head, $25 in War Stamps.

Terms and Conditions

The entrants will submit *four copies* of a report of not more than 2,000 words (with *one set* of any appropriate photographs, printed material or exhibits pertaining to the program if desired) covering the following three classifications, to which the indicated weighted merit rating will be given by the Judges.

1. The Home Service Department's activities to further electrical living through the maintenance, conservation, repair and use of electrical household equipment; other activities to build good will. (45 points)

2. The Home Service Department's activities participating in the 1944 War-time program of food conservation and preservation. (45 points)

3. A summary of the department's achievements, briefly tabulated to enable the contest judges to gain an accurate concept of the accomplishments of the department. (10 points)

It is the intent of this award to place the accomplishments of large and small electrical utility Home Service Departments on an equal footing in competition.

In order to guide the Judges each report shall have a foreword giving the following information:

1. Total number of residential customers—January 1, 1944.

2. Brief description of territory served—concentrated area or scattered, with preponderance of small communities.

3. Number of company offices from which the activities were carried on and the number of participating Home Service workers.

4. Joint activities with dealers or straight company operation.

Elaborate reports are not desired. Rather a simple, straight-forward statement of facts will be preferable, having in mind the points which the Judges will need in making the Award. However, *one set* of samples of printed or mimeographed material used should be included.

No company Home Service Department and/or Home Service Director having previously won *first prize* in the Laura McCall Award shall be eligible for the same prize until two successive years have elapsed.

The contest period will cover the calendar year 1944 and Reports and Exhibits must be mailed to the offices of Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y., not later than midnight, May 15, 1945.

PERSONALS

ELMER L. LINDSETH has been elected executive vice-president of the Cleveland Electric Illuminating Company.

Mr. Lindseth began with the Illuminating Company in 1924 as a junior test engineer. He subsequently became production engineer, assistant to the executive engineer, assistant to the president and in 1942, vice-president in charge of sales and related matters.

He is a graduate of Miami University, Case School of Applied Science, and the Graduate School of Yale University where he received a master's degree in mechanical engineering.

For the past two years, Mr. Lindseth has been active in postwar planning, and is Cleveland chairman of the Committee for Economic Development. He was formerly vice-chairman of the Greater Cleveland Postwar Planning Council. He is a past president of the Case Alumni Association, and a former alumni trustee of Case School.

J. HERBERT WALKER has been elected a vice-president of the Detroit Edison Co. Mr. Walker has been assistant to the general manager and superintendent of central heating. He has been an engineer-executive of the company for many years, and was first employed by it in 1912. As assistant to the general manager, he has been active in organization planning matters, and as a consultant on various commercial and economic problems affecting special industrial service. He has a wide experience in company affairs.

JAMES H. LOBBAN was elected secretary of the Detroit company to succeed Russell W. Symes who, having reached retirement age, retired as vice-president and secretary. Mr. Symes was elected a director last February and was appointed by the board as tax advisor for the ensuing year.

Mr. Lobban started work for Detroit Edison in 1910 on electrical construction work. He was employed as an engineer in the statistical division in 1911, and was successively promoted to property engineer, assistant general accountant, assistant secretary and general accountant. He has been active in utility industry affairs, serving on many accounting committees and as chairman of the accounting section of the Edison Electric Institute.

WALTER R. KEAGY has been appointed a vice-president of the Cincinnati Gas & Electric Company. Mr. Keagy entered the Cincinnati organization in 1929 as manager of its Customers' Service Department. He is secretary-trustee of the Cincinnati Electrical Association and is a member of the Customers' Activities Committee, Accounting Division, of the Edison Electric Institute. Prior to joining the Cincinnati Gas & Electric Company, Mr. Keagy was assistant manager of the Cincinnati District of the Westinghouse Electric and Manufacturing Company.

ROY R. KATTERHENRY has been promoted from purchasing agent to executive assistant of Indianapolis Power & Light Company. He started on construction work at the Mill Street plant in Indianapolis in 1916 as an electrical engineering graduate, and next worked in plant research and stores. He advanced to general storekeeper in 1919 and purchasing in 1924. In his new position he retains supervision over stores and purchasing.

Due to increased engineering duties connected with the Indianapolis company's present and postwar construction program, PAUL F. HELM has been named assistant to the vice-president in charge of operation-engineering to give full time to the direction of engineering and WILSON A. GENTRY has been appointed assistant to the vice-president in charge of operation-operating. Both men will assist vice-president Dan C. Hess.

Mr. Helm started on power plant layout in Lebanon, Ind., after leaving Purdue University in 1909, and was employed by Interstate Public Service Co. in Lebanon, Indianapolis and Franklin, Ind., until 1918, when he joined the I.P.&L. organization as research engineer. He became superintendent in 1927, chief designing engineer in 1928 and assistant to the vice-president in charge of operation in 1941.

Mr. Gentry, who was superintendent of operation for Memphis Power & Light Co. from 1925 to 1939, continued in that position for the Light, Gas & Water Division of the city of Memphis until called to Washington, D. C., for war service in May, 1942. He served as area engineer and later as regional co-ordinator in the Office of War Utilities, War Production Board, until going to Indianapolis this month. Starting in 1914 with Westinghouse Electric & Manufacturing Company in East Pittsburgh, Pa., he also was employed by electric utilities in New York City, Duluth, Minn., and Charlotte, N. C., until 1923, and during the next two years worked with utility engineers of the eight Southeastern states as district meter and relay engineer for Westinghouse.

ERNEST J. HOWE of South Orange, N. J., for a number of years vice-president of NY PA NJ Public Utilities Company, with offices at 61 Broadway, New York, has been appointed vice-president in charge of finance for the Rochester Gas and Electric Company and has moved his family to that city to take up his new duties there.

LEE D. FERDEN, widely known Saginaw County farmer, has been elected a director of Consumers Power Company, which supplies electric service to 79,000 farms in 57 Michigan counties.

Born in Iowa 40 years ago, Mr. Ferden came to Michigan to engage in farming after graduating from a business college in Illinois. He operates a 200-acre farm near Chesaning, 40 acres of which are used for experimental purposes in cooperation with the Michigan Crop Improvement Association and Michigan State College. He developed Ferden's yellow dent seed corn, and he grows this product and also certified seed wheat, oats and beans. He has won many awards at state, national and international grain shows.

He is a member of the Saginaw County Farm Bureau and the Michigan Crop Improvement Association, and a vice-president of the Saginaw County Fair Association.

ROBERT A. HENTZ, electrical engineer in charge of the electrical engineering division of the Philadelphia Electric Co., who has been disabled by ill health during the past sixteen months, has retired from active duty after more than 33 years of continuous service. Entering the engineering department of the company in 1911, as an electrical designer, he became assistant superintendent of the station construction division in 1919, and superintendent in 1925. At the time of the engineering department's reorganization in 1929, he was appointed electrical engineer.

(Continued on page 120)

E.E.I. PUBLICATIONS AND SERVICE MATERIAL

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Proceedings—National Accounting Conferences		
Complete Set—8th Conference 1944	2.00	2.00
" " 7th " 1943	2.00	2.00
" " 5th " 1941	2.00	2.00
" " 4th " 1940	2.00	2.00
" " 3rd " 1939	2.00	2.00
" " 2nd " 1938	1.50	1.50
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Depreciation	.50	.50
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General Sessions	.50	.50
Summary of Definitions Covering Depreciation and Related Terms 1939. Statistical	1.00	1.00
L-2—Electric Light and Power Industry in 1943 (1944)	.30	.75
K-2—Electric Light and Power Industry in 1942 (6/43)	.75	.75
J-2—Electric Light and Power Industry in 1941 (5/42)	.30	.75
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Engineering Committees

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10— 99 "	.08 "	
100—499 "	.06 "	
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J-8—Utilization Voltage Standardization Recommendations 1942	.20	.50
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"Time to Relight"—(Commercial) sound slide 15 minutes, 85 pictures	$10.00 film & disc	
"Light Up—Step Up"—(Industrial) sound slide 15 minutes, 75 pictures	$10.00 " " "	
"You Can Do Something About It"—(Home) sound slide, 15 minutes, 95 pictures	$10.00 " " "	

PERSONALS

(*Continued from page* 118)

Mr. Hentz has been active for many years in national electrical committee work including the Edison Electric Institute, the American Institute of Electrical Engineers and the Association of Edison Illuminating Companies, and has served as chairman in several cases.

BERNARD L. PALM will return to his position as commercial manager of the Central Illinois Public Service Co., Springfield, Ill., upon his retirement from the Army in April. Captain Palm will revert to inactive status, having served in the Army Air Forces for two and a half years.

NEWTON JACKSON, formerly electrical engineer at Charlottesville, Va., for the Virginia Electric & Power Co., has been appointed substation design engineer in the system engineering department of the company at Richmond, Va. R. COOPER BAILEY, who has been serving as Lieutenant Commander in the U. S. Naval Reserve, has been appointed electrical engineer in the system engineering department at Richmond, Va.

WALTER T. ACKERMAN, formerly head of the department of agricultural engineering and research at the University of New Hampshire, has been appointed farm service director of the Connecticut Light & Power Co., with headquarters at Waterbury. Mr. Ackerman was connected in his earlier career with the University of Connecticut's mechanical and agricultural engineering departments, being in charge of the latter after serving in World War I. He held a teaching fellowship at Iowa State College from 1920 to 1922, receiving his A. E. professional degree there in the latter year, and taught at Iowa State and Virginia Polytechnic Institute until 1925, when he went to New Hampshire.

W. H. UDE, who has been connected with the Washington Water Power Co. for more than 22 years, will retire on April 1. Mr. Ude became director of public relations for the Spokane utility in 1923. Successive promotions made him director of the claim, tax, right of way and personnel departments. During his residence in Spokane, Mr. Ude participated actively in civic affairs. He took part in establishing the Washington committee on the relation of electricity to agriculture, which did pioneer work in irrigation, use of power on the farm, electrical incubation and brooding and many other valuable aids to agriculturists.

Wiring		
Rewiring for Commercial and Industrial Buildings	$0.25	$0.25
Handbook of Interior Wiring Design—1937	.50	.50
Basic Factors of Adequate Wiring—1939	.25	.25
Covered Neutral Cable Helps Sell Adequate Home Wiring—1939	.25	.25
Commercial Building Re-wiring Market—1939	.35	.35
	(Price on above three books as a group is 60c per set)	
Films		
Commercial Re-Wiring — lantern slides	Set	$17.50
Home Wiring—lantern slides	Set	25.00

Miscellaneous, Reference Books, etc.

Code for Electricity Meters (1941)	$1.60	$2.00
Good Radio Reception (1937)	100 copies	4.00
	1000 "	25.00
	3000 "	60.00
	5000 "	95.00
Objective Type Rates, 1933-1936	.80	2.00
Ice and Wind Loading Tables for Overhead Line Conductors (Revision of Tables 85 to 96 of the Overhead System Reference Book) 1942	1-4 copies	10c
	5-49 "	6c
Power Sales Manual, plus Sec. 12-13-14 of 1944 (1941)	4.75	7.00
Rate Book for 1943	10.00	25.00
Rewiring for Commercial and Industrial Buildings (1941)	.25	.25
Sales Training Manual—Commercial Electric Cooking (1941)	1.50	1.50
Storm Loading and Strength of Wood Pole Lines and a Study of Wind Gusts (1936)	2.00	5.00
Weekly, Monthly and Annual Statistics (Includes Annual Statistical Bulletin; Weekly Electric Power Output; Monthly Electrical Research Statistics)	2.00	2.00

Periodicals

Better Light—Better Sight News (9 issues yearly)	$0.75	$0.75
Edison Electric Institute Bulletin (Monthly)	2.00	2.00
Rural Electrification Bulletin (5 issues yearly)		1.00

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